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THE AUTOMOBILE

Akron's Enormous Annual Tire Bill

$140,000,000—Casings Represent $77,500,000, Tubes $34,320,000, Solid Tires $28,600,000

PERATING 24 hours a day for five days a week and overtime on Saturday, the tire makers of Akron are striving to meet the demand for automobile casings and inner tubes as never before in the history of the industry. During the month of April the average production of casings in Akron will prove to be 7750 per day, with the maximum in the neighborhood of 8000 shoes. There are 6100 men actually employed in the processes of making tires, exclusive of executive and administrative officers, and if any of the Akron companies could find space for more equipment and men to operate the machines, both equipment and men would be added at once to their establishments.

In a word, the world's manufacturing center, as far as automobile tires are concerned, is under terrific working pressure, the reason being that for a short time early in the season the generally pessimistic outlook for the automobile in-

dustry was reflected in the tire making trade, and, as a consequence, stocks have been depleted and the Spring demand has proved so insistent and tremendous in volume that the capacity of all the plants is now being subjected to a fierce test.

Reckoned at an average price of $35, the shoes made in Akron every working day in April have a money value of $271,250. And if that rate should be maintained throughout the year the return in cash to the Akron factories would approximate $77,577,500. In addition to this vast sum, the returns from the production of inner tubes must be added. It has been estimated that the average consumption of tubes is twice as large as that of casings. If that figure is correct, and if the Akron factories maintain the proportion of manufacture, the tube production would not be far from 15,000 per day. At an average price of $8 the sale of tubes would bring in $120,000 a day, or $34,320,000 in the course of a year.

Output $400,000 a Day

Assuming that the careful canvass of the situation by a staff representative of THE AUTOMOBILE produced at least approximately correct figures, the value of the daily output of casings and tubes from the ten active companies of Akron in April will average $391,250, which enormous figure, carried out for a year, would make $111,897,500.

The weight of all the pneumatic tires made in Akron in a year would be not far from 100,000,000 pounds, exclusive of tubes, or 50,000 tons. Roughly, the amount of cotton fabric entering into this production is 12,500 tons, thus leaving 37,500 tons of rubber composition to make up the remainder of the total. The cotton cloth used in tire making is made of long-fibered material, known to the trade as Sea Island cotton, which comes from the Atlantic coast islands from North Carolina to Georgia and extending into the lowlands of the latter State. Egyptian cotton is also available to some extent. Some of this cotton web costs as much as 75 cents a yard, but the average is considerably below that figure. Assuming that the cost is about 50 cents a pound, the value of the cotton that enters into the annual production of tire casings in Akron is about $12,500,000. The amount of pure up-river Para, which is used exclusively by all the factories, according to their official statements, in the manufacture of tires, varies with the brand and model and size.

Suffice it to say that the material that enters into the composition of the Akron tires in a year costs not a great way from $50,000,000. The bill for labor would approximate $5,000,000, while administration, selling and interest on the investment would account for fully $10,000,000. This would leave a margin of something like $12,500,000 for profits and dividends and surplus.

In the item covering the cost of materials, a large element of labor is included for the production of the cotton and rubber and other elements of the tires, and for their transportation to the factories.

Thus it will be seen that the business of tire making, while profitable, is not wildly or unduly so. The business has made a regiment of rich men, but they were not made rich over night. In fact, the gigantic industry as it is typified and exemplified at Akron is a cold, hard business proposition, in which the returns are not like those of a bonanza silver strike or a lucky plunge in the "Street." It ceased to be a perilous venture when the automobile flashed upon the horizon of civilization, and now it has settled down into a vast business to furnish one of the chief elements in the operation of the automobile.

There are men in Akron to-day, high up in the councils of the big factories and independently rich, who did not have a dollar fifteen years ago. There are scores of prosperous business men who were employed at small wages less than ten years ago. One instance is cited where the executive head of one of the giant companies came to Akron a dozen years back with $250. To-day he is reputed to be worth many millions.

The average automobile pneumatic tire casing weighs about thirty-two pounds. It is composed of about 25 per cent. or eight pounds of cotton webbing of the heaviest and strongest variety and 75 per cent. or twenty-four pounds of rubber composition. The cotton is specially woven for tire making and is delivered to the factories ready to be used for that purpose. It comes in various shapes, but the ordinary condition at delivery is in cylindrical rolls, something like print paper to a newspaper publishing house.

The rubber is delivered to the factories in much the same shape it took when it was gathered in the tropical forests, and made into biscuits in the smudge arising from burning palm nuts. There is a growing tendency to use plantation rubber produced in the cultivated fields of Ceylon, the East Indies and the South Seas. Each of the Akron factories has a large storeroom in which its supply of crude rubber is placed. Usually this is in the cellar of the main factory building. In some of the larger establishments the amount of crude rubber in store foots up into the millions of pounds.

The first process in tire making is to soften up the biscuits by placing them in hot water. The lumps frequently weigh as much as fifty pounds, but the average run is smaller. The hot water is contained in vats and the biscuits are allowed to soak until they are soft and soggy. They are then removed to the breaking machines, which are equipped with corrugated rollers between which the lumps are crushed, rolled and masticated until the mass of crude rubber resembles a rude sort of pulp.

This pulp is then placed in the washers, which consist of tanks filled with hot water, through which a constant current is produced by means of revolving paddles.

How The Tires Are Made

The next step is to take the pulp to the sheet machines, a series of rollers upon which a current of water is directed, and in passing between the rolls the pulp is freed from every trace of grit and foreign substances. These rolls also serve to press out the washed rubber into thin, porous sheets, from which a considerable amount of water is expelled in the final turn of the rolls. The crepe, as it is termed in this stage, is taken to the drying rooms, where for many hours it is subjected to a slow heat to evaporate all the remaining water.

In the process of macerating, washing and drying, all rubber loses something of its original weight, this element of loss depending upon the quality of the crude rubber. In the finest grades of Para there is only a small loss, but in some of the rougher kinds of crude the shrinkage is a serious factor, often amounting to 25 per cent., and in some cases to as much as half by weight. The reason for this is that sand, vegetable growths of various kinds, stones and even small animals sometimes find their way into carelessly made biscuits, and the opposite is true where due care is used in preparing them.

Considerable quantities of the crude rubber are pulped, washed and dried and then stored for use as required, the space given over to this storage often amounting to an immense total.

When the factory is ready to use the dried rubber, it is removed from the storeroom and given its taste of milling. First it is rolled long, carefully and vigorously, until it has a soft and tacky consistency, and then the key move to the whole process of rendering the gum available for use in tires and other rubber products is made. The rolled rubber is mixed with the vulcanizing chemicals, which are based upon sulphur, but which also contain several other chemicals in large quantities.

The exact nature of this chemical mixture is a jealously guarded secret in every rubber factory. It varies in each establishment, and the mixture that is considered best for tires of the pneumatic variety would not do at all for solids, and the mixture that has proved good for solid tires would not be at all available in the manufacture of seamless bottles.

On the general average it is likely that the chemicals used in tire making weigh quite as much as the crude gum rubber; at least fully as much chemical is placed in the milling machines

with the rolled gum. This proportion may not be maintained, as it is possible that the water which is used in several of the later stages may dissolve some of the chemical.

In a 32-pound tire, which is composed of at least eight pounds of cotton webbing, worth approximately 50 cents a pound, at a conservative estimate, as most of the factories state that the cotton used by them costs 70 cents and even more, there must be twenty-four pounds of other substances. If twelve pounds of pure up-river Para gum are used in each, costing $2 a pound, more or less, and the chemicals are worth 5 cents a pound, the total cost of materials in a tire would be $28.60. Say that the labor, selling, interest and other charges on the tire are $5, the selling price of say $35 does not seem excessive. As a matter of fact, the tire manufacturers are not what might be termed anxious to go into the actual details.

The first process of milling mixes the chemicals closely with the gum and kneads the mass into a state of plasticity, when it is ready for the friction calender. This machine looks something like a cylinder printing press and the cloth is fed into it from one side, while the mixed stock is drawn in from the opposite side. The rubber is laid upon the surface of the cloth, which is drawn slowly between opposed rolls. These are so closely adjusted that their action forces the rubber into the web and when it emerges after the process the fabric is impregnated with the gum to its last thread.

The impregnated cloth is then coated with a layer of rubber and the cloth is cut into appropriate lengths, widths and thicknesses for tire making.

Finishing and Vulcanizing

The scene now changes to the tire factory, where the actual building takes place. The room generally has no whirring machinery and its feature is the presence of lines of iron tire cores or molds, upon which the various structural elements are spread. The initial process is to place a layer of the prepared cloth upon the iron core. The rubber side is put outward and after it is carefully fitted into the mold another layer of cloth is applied, with its cloth side against the rubber surface. This continues until the series of layers has reached the required number, which may vary from three or four to seven or eight. On top of this layer of cloth and rubber a thicker stratum of the gum is placed, and then comes another ply of the prepared cloth.

The tire in this shape is ready for its tread to be applied. Treading of a tire consists of spreading upon the layers of cloth enough rubber to bring the tire to its required size and shape. Each step in the preceding process is accomplished with the utmost care to secure uniformity and mechanical exactness by rolling and shaping.

The final stage of manufacture is the smoothing process that is given each tire when it comes from the makers. This is accomplished by various methods and means, and when it is finished the tire is ready for vulcanizing.

Vulcanizing changes the character of gum rubber from its plastic and unstable condition to one of permanence and elasticity, where it is not so susceptible to the influences of heat and cold, making it available for human use as automobile tires or insulated cables or water-proof boots and clothing.

The process of vulcanization is accomplished by the application of heat to the finished tires. The uncured tire is placed within a mold made in half sections, which are locked down upon the tire and subjected to very heavy pressure. The mold is then put into the heater, where for a certain definite length of time it remains at a uniform degree of heat. The degree of heat and length of time used in this stage of tire manufacture are never made public property, but they are both considered as among the most essential elements in manufacture. Too long exposure makes quite as bad a tire as one that is too short, the one turning out a brittle article while the other produces a soft tire.

When the proper time has arrived the tire is removed from the heater and the mold is opened. The heat and pressure have done a radical work, for the gum, chemicals and cloth are associated in a new substance that is unlike any of its component parts. The chemicals and the gum have become one, and the cloth, while still assuredly cotton webbing, has become a reinforcement for the tire.

The cured article is pried loose from its iron core and after a final inspection is given over to the finisher, who smoothes away the little inequalities resulting from the process of molding, and after another examination the tire is ready for the stock room. Non-skid treads and the other variations from the usual smooth tread tires are simply variations in process.

Making Solids Is Simpler

In the making of solid tires the method is simpler. The prepared material is shaped by being forced through tubes gauged to the size and shape of tire required. The uncured tires are fitted with wire protection in some cases, and the method of vulcanizing is to stretch out the material in its proper shape and subject it to heat, pressure and molding by placing a heated mold upon it, keeping the temperature uniform during the process by steam heat.

Inner tubes for pneumatic tires are made as a general thing by wrapping thin sheets of prepared rubber around iron mandrels until the desired thickness is secured. With each turn of the rubber the operator presses the layers together with a hand roller, and when the tube is thick enough the mandrel is carefully wrapped and placed in steam heat for vulcanizing. It is infinitely faster than the process of making shoes, and one man and machine can turn out many tubes in the course of a day.

When the vulcanizing is completed the iron rod bearing the tube is removed from the heat and the tube is stripped from the rod by mechanical means. The ends of the tube are then smoothed and prepared for joining, which is accomplished by splicing.

After the shoes and tubes and solids have served their purpose as an important element of automobiling they are not useless. Processes for reclaiming the rubber they contain have been in use almost from the time the first rubber goods were manufactured. Probably the latest development along the line of reclaiming old rubber is that of the Alkali Rubber Company of Akron. This concern is not a factor in the tire situation except as a consumer of old tires. By a series of mechanical and chemical steps this company removes the old rubber from its original condition, and after maceration and a number of processes to take out the original vulcanizing chemicals it makes up the renovated rubber into a variety of useful articles.

There are nineteen concerns manufacturing rubber in Akron to-day. Of these there are ten active tire-making companies. These plants are bunched in four groups consisting of the Goodrich and Diamond in one; the Firestone, Star and Miller in another; Goodyear, Consolidated and Stein in a third, and the Swinehart and Royal, which are separated by a considerable distance, and not really susceptible to grouping. Each of these ten concerns is as busy as its capacity will allow.

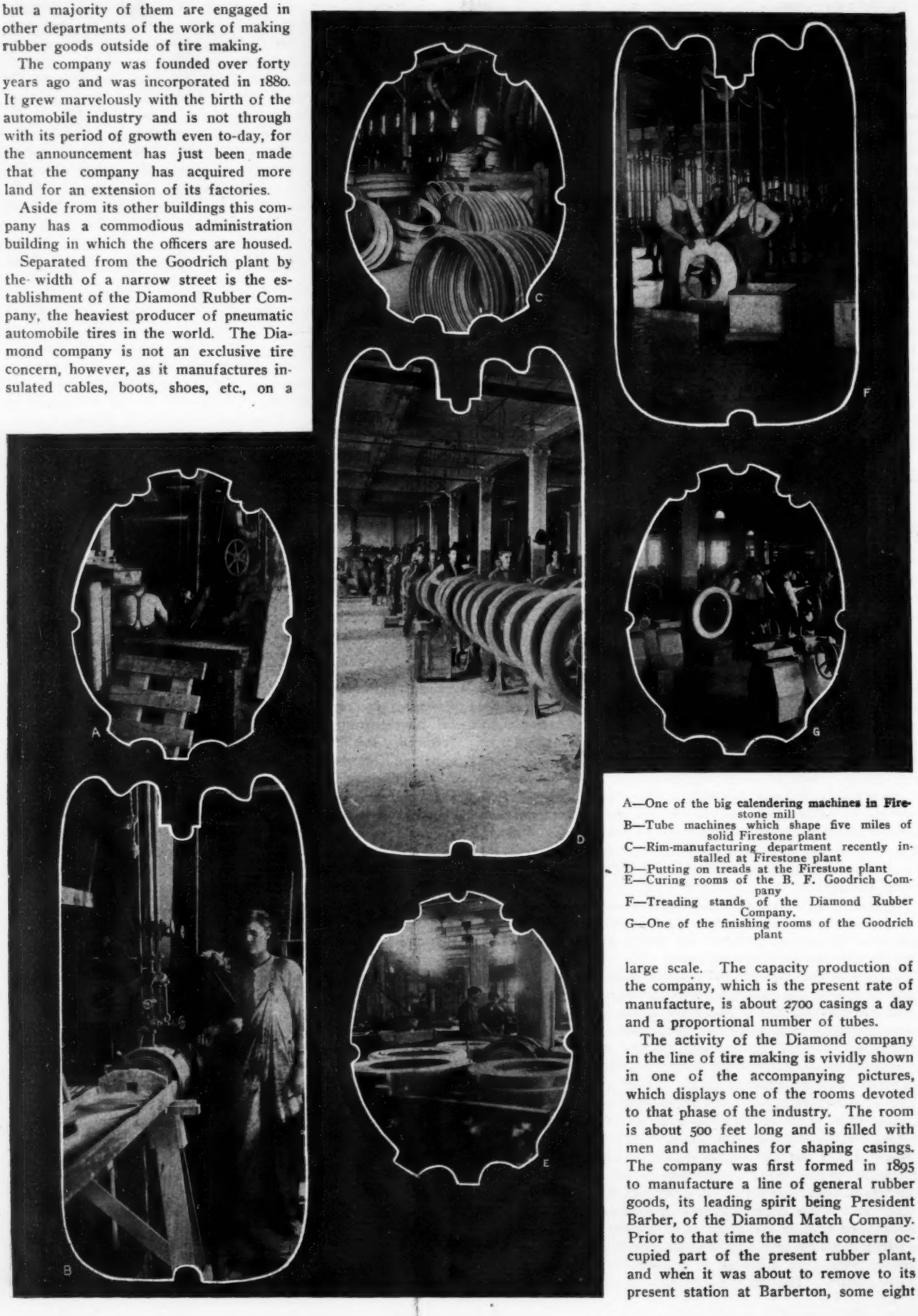
The plant of the B. F. Goodrich Company lies on South Main street, about a mile from the center of Akron. The factory is the largest rubber making concern in the world. It has a street frontage of 1000 feet and its site is in the form of a rough rectangle, with a still wider base on the canal in the rear of the lot. In all of its departments it has an available floor space of between thirty-three and thirty-four acres, and in going around the buildings on the edge of the property one would have to travel one mile, less 63 feet. The company is not exclusively engaged in tire making, only one section of the industrial activity of the organization being exerted in that direction. But the turnout of the Goodrich company is approximately 2000 tire casings per working day and probably 4000 tubes. There are more than 5000 men employed in this plant,

but a majority of them are engaged in other departments of the work of making rubber goods outside of tire making.

The company was founded over forty years ago and was incorporated in 1880. It grew marvelously with the birth of the automobile industry and is not through with its period of growth even to-day, for the announcement has just been made that the company has acquired more land for an extension of its factories.

Aside from its other buildings this company has a commodious administration building in which the officers are housed.

Separated from the Goodrich plant by the width of a narrow street is the establishment of the Diamond Rubber Company, the heaviest producer of pneumatic automobile tires in the world. The Diamond company is not an exclusive tire concern, however, as it manufactures insulated cables, boots, shoes, etc., on a



A—One of the big calendering machines in Firestone mill
B—Tube machines which shape five miles of solid Firestone plant
C—Rim-manufacturing department recently installed at Firestone plant
D—Putting on treads at the Firestone plant
E—Curing rooms of the B. F. Goodrich Company
F—Treading stands of the Diamond Rubber Company.
G—One of the finishing rooms of the Goodrich plant

large scale. The capacity production of the company, which is the present rate of manufacture, is about 2700 casings a day and a proportional number of tubes.

The activity of the Diamond company in the line of tire making is vividly shown in one of the accompanying pictures, which displays one of the rooms devoted to that phase of the industry. The room is about 500 feet long and is filled with men and machines for shaping casings. The company was first formed in 1895 to manufacture a line of general rubber goods, its leading spirit being President Barber, of the Diamond Match Company. Prior to that time the match concern occupied part of the present rubber plant, and when it was about to remove to its present station at Barberton, some eight

H—Washing machines working on raw rubber at Firestone factory
I—Electric welding machine in Firestone rim factory
J—Giant mill-room of the Goodrich plant
K—Tire-making room of the Star Rubber Company
L—Where inner tubes are made at Firestone establishment
M—Plating vats in Firestone rim factory
N—Vulcanizing room of the Firestone Company showing heaters and molds

miles from Akron, some use had to be found for the buildings. This purpose was found in the rubber company. Three years later the company was reorganized and entered the automobile tire-making field. F. A. Hardy, of Chicago, is president; A. H. Marks is vice-president and general manager, and W. B. Miller and A. H. Noah are directors.

Passing further out South Main street for a mile or more one comes to the next group. The factories are situated below Main street, the old Firestone plant being by far the largest and busiest. This factory occupies about four acres of floor space and is the largest exclusive manufactory of tires in the world. It makes nothing but tires and rims, and its turnout of solid tires foots up to an enormous figure. The daily production of this factory is 1000 pneumatic tire casings, 2000 inner tubes and five miles by length of solid tires of various sorts and descriptions. As shown in one of the illustrations there are two tube machines for making solid tires. The openings may be adjusted to any desired size and shape and the composition from which the treads are to be made is forced through, emerging like big snakes into troughs that have been liberally covered with powdered soapstone. The rate of progress is 45 feet a minute, and the troughs are just the length of a wheel circumference. When the length of the rubber snake reaches that of the circumference of the wheel a workman slices it off and clears the way for another.

Much of this work is for motor buggies and horse-drawn vehicle equipment, but the bulk of the work is for truck tires. Working ten hours at full speed each of

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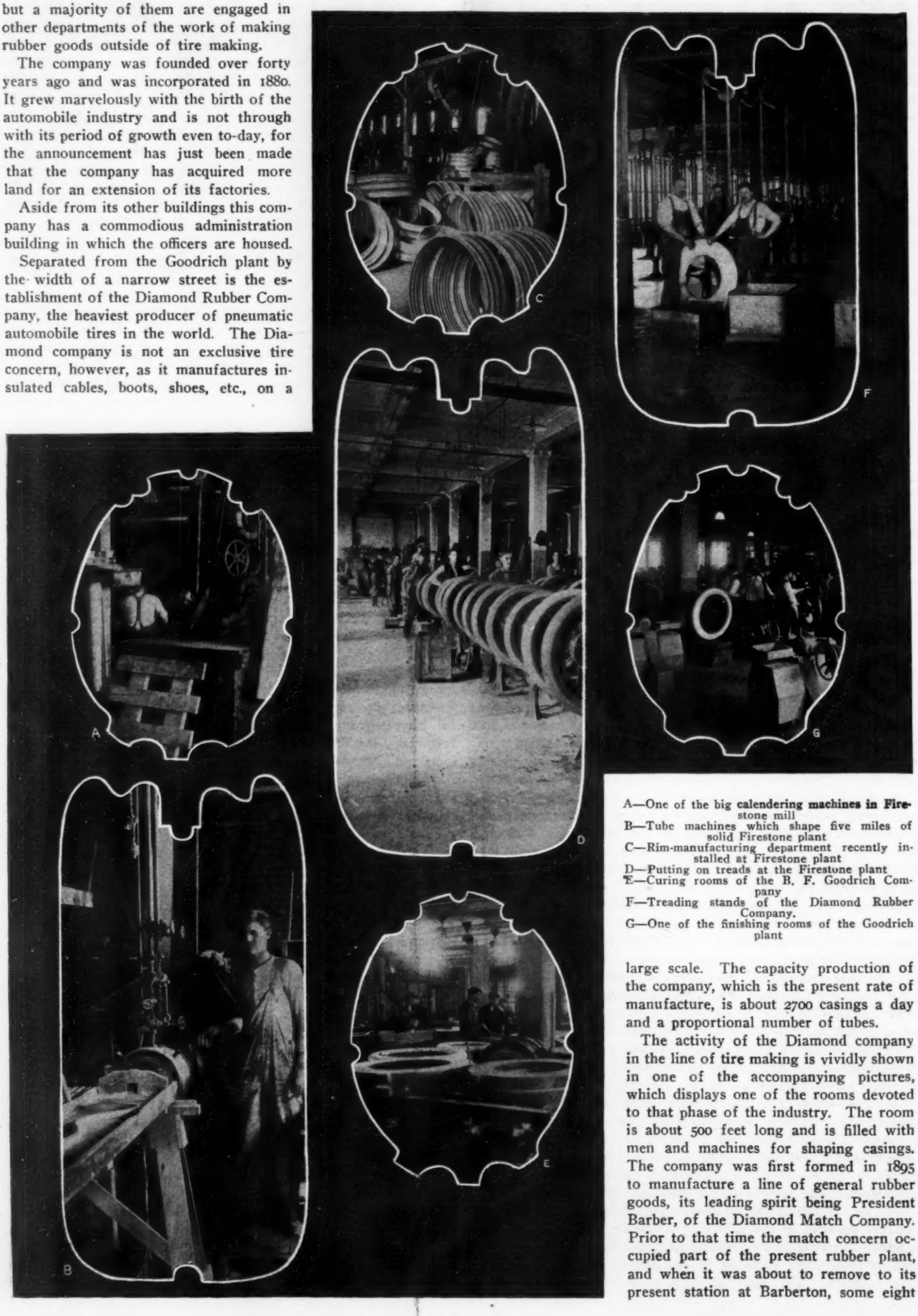

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these machines is capable of turning out five miles of solid tires, but as that amount represents 1600 buggy tires or 2100 truck tires, the tremendous volume of this production can only be approximated, as the aggregates run into impossible figures and the number of variables increase astonishingly as the rate of production goes up.

The Star Rubber Company's factory and offices are situated next to those of the Firestone. The Star is a comparative newcomer in the automobile tire-making field. It is not a big producer, although it is a factor in the situation.

About half a mile further out is the establishment of the Miller Rubber Company. This concern, while small compared with some of the giants, is an active producer and seems to have about all the manufacturing business it can handle under the prevailing high pressure

The third group of factories is far over in the East End, a run of seven or eight miles by the devious and uncertain streets. The giant of this group is the plant of the Goodyear Tire and Rubber Company. In the manufacture of pneumatics this company ranks very high, the high-pressure capacity of the plant being about 1600 casings a day. The Goodyear company also makes an immense number of tubes and manufactures some extensive lines of cushion tires for allied concerns.

The other factories in the third or East End group are those of the Consolidated Rubber Tire Company, which is allied with the Buckeye, and the Stein Automobile Tire Company. The Consolidated has a large factory back of the Number 2 plant of the Goodyear company. It is aggressively managed, and the output this season will be very much larger than was contemplated last Fall.

The Stein company is smaller than the Consolidated, has a complete plant and is making an active bid for its share of the business. The Royal Rubber Company is a rather recently formed concern, having a factory near the center of town.

The Swinehart Tire and Rubber Company, which succeeded to the business of the Swinehart Clincher Tire and Rubber Company, is located in the hollow on the opposite side of Akron from the Firestone plant. This company turns out some 200 casings a day, a proportionate number of tubes and three tons of solid tires of various kinds.

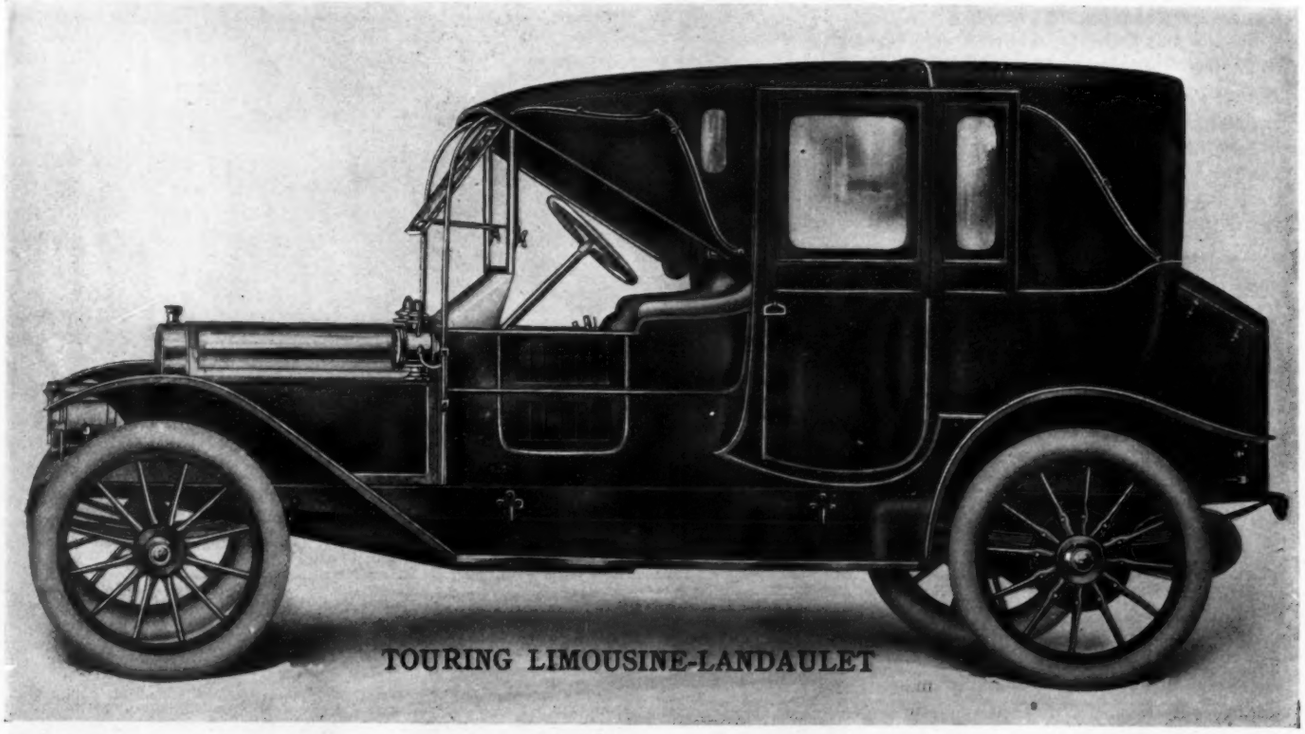
Including casings, tubes, cushion tires and solids the gross value of Akron's output this year will probably reach $140,000,000 at a conservative figure.

Generally speaking there are in operation in the United States 480,000 automobiles. If each of them requires eight casings a year the total number to be supplied would be 3,840,000. The Akron factories turn out at capacity 2,216,000, or just short of 60 per cent. The percentage of tubes is somewhat less, but the proportion borne by the production of solids in Akron to the total production is much higher.

New Touring Limousine-Landaulet

Designed for Comfort During Extended Tours

Illustrating a limousine-landaulet, showing first the finished appearance of this type of body on a conventional type of automobile, and second, the working drawings of the body, with sufficient detail to permit a body-maker to reproduce the same, with provision for tires within the body, and a place for a trunk at the back. The internal arrangements are contrived for the special accommodation of two persons and



TOURING LIMOUSINE-LANDAULET

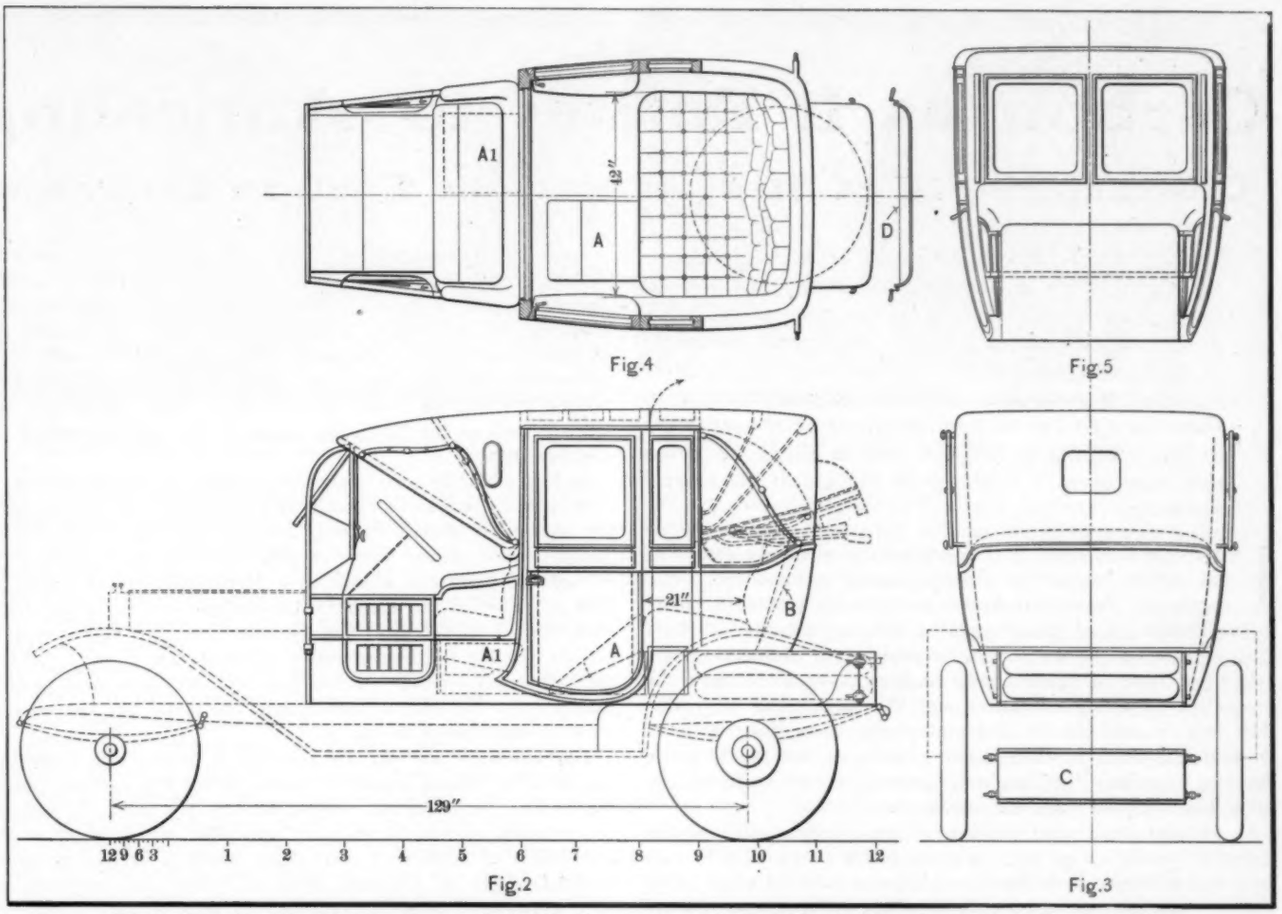


Fig. 2—Side elevation of touring limousine-landaulet. Fig. 3—Rear elevation. Fig. 4—Plan view. Fig. 5—Front elevation

a chauffeur. The seats for the passengers are of the adjustable type, affording the comfort of a "Morris" chair. The top folds up to two positions at the front, and back of the side doors the top folds down.

DISTINGUISHING between touring under ordinary and favorable conditions and the long jaunts that extend through several countries, perhaps taking up two or three months of time, makes it necessary to provide for the extended tour on a basis that will more nearly accord with the demand under the more exacting conditions, with specific reference to the comfort and convenience of the tourist.

Those who have traveled day after day, occupying cramped positions in poorly contrived bodies, will testify willingly to the lack of foresight of the designer who labors under the impression that there is any enjoyment under such conditions. To generously disagree with designers of bodies is a very simple thing to do, but the real difficulty lies in the lack of appreciation of the limitation that surrounds designers, who are compelled, through force of circumstances, to produce compromise designs.

If an automobile is to be used under conditions of general service it is highly improbable that a special touring body, as here presented, will be the most fitting selection, due to the fact that the body is relatively heavy, and the cost of maintaining the car will be increased accordingly: first, if the car is of relatively light construction, in which event the body will be somewhat overgrown, affecting the life of the car, and, second, if a more pretentious automobile is selected in conjunction with a large touring body, the responsibility will be increased too much for comfort in every-day work.

The body, as here illustrated, under the circumstances, must be looked upon in the light of a special effort, to be taken advantage of under conditions of long tours. The tourists must have accommodation for wearing apparel, and the equipment must include extra tires, under conditions that will protect them from the inclemency of the weather, and the longing eyes of the type of citizen who expresses a fondness for other people's property. A study of this design of body will suffice to show that its characteristics are in accord with approved requirement, and among the points of merit mention will be made of the low fore-door, with two rows of shutters, by means of which ventilation of the space within the front of the body is established. In addition to the flexible windshield, fitted with a leather skirt at the lower edge, closing in the joint between the windshield and the dash, a leather hood is provided with means for raising same entirely or in part for the protection of the occupant of the front seat, varying the same to accord with the frivolities of wind and weather.

Remembering that the rear seat is designed for the comfort of two persons, it remains to point out that the location of the seat is well to the front of the rear axle. The side-door windows are so designed as to be dropped down at will, and the sides, also the front and the top being covered entirely with leather, are provided with means for folding, as shown by the dotted lines in Fig. 2.

One of the most novel features of this body is represented in the provision that is made in the form of a compartment in the rear for the tires, also the location of a generous-sized trunk, with suitable means for fastening the same in its position at the rear of the car.

WASH A CAR WITH CLEAN WATER.—It very often happens when soapy or dirty water is permitted to dry upon the surface of a car body it leaves a disfigurement impossible to remove unless the surface be rubbed with water and pulverized pumice stone and revarnished. The lesson is, therefore, to avoid splashing unclean water on the surface of the body.

Carbon as It Relates to Annealing

Characteristics of Steel of Various Carbon Contents

E. F. Lake shows photomicrographs of steel of various carbon contents in the annealed state, pointing out the carbon condition in each case, and as the story goes, it is possible to identify the several specimens of steel, using the microscope for the purpose after the steel is annealed. It is the idea in this case to show the effect of carbon variations on the structure of the steel and to tell how carbon alters the structure, also what to expect from the use of the several products.

IN the annealed steels it is possible to very closely determine the carbon content by a microscopical examination. The microscope shows that steel is not a simple substance, but is a conglomeration of the crystals of different substances. Ferrite, pearlite and cementite can be seen in the ordinary carbon steels that have been thoroughly annealed. When we know the properties of these substances and the proportions in which they exist in steel we can determine many of its characteristics. In actual practice, however, some allowances have to be made for the impurities that might be present in the metal or for other ingredients or alloying materials.

If we take steels with varying carbon contents and give the different samples a perfectly smooth polish and etch this surface with picric or hydrofluoric acid, tincture of iodine or other etching materials, we can clearly see these different constituents under the microscope. Starting with carbonless iron that is pure, we find ferrite to be the only constituent. When we begin to add carbon, however, pearlite appears and gradually increases until 0.85 per cent. of carbon has been reached. At this percentage the pearlite has completely driven out the ferrite and is the only constituent that shows. From this point on cementite begins to appear, and if it were commercially possible to make steel that contained 6.60 per cent. of combined carbon without any graphitic carbon being present the cementite would obliterate the other two constituents and be the only one seen in thoroughly annealed steel. This is graphically shown by the chart in a former article entitled "Elementary Talk on Steel Composition."

The ferrite crystals in theory contain no carbon or other impurities. The properties of ferrite are such that the greater its percentage the greater will be the metal's softness and ductility, and the higher will be its electric conductivity and magnetic strength. When steels below 0.85 per cent. of carbon are polished and etched with picric acid their surfaces will show white with dark masses. The white is ferrite and the dark masses are pearlite; consequently these dark masses are the more numerous the closer we approach the carbon content of 0.85 per cent.

In Fig. 1 will be seen a photomicrograph of a steel so low in carbon that it might be classed with the irons. As will be seen, the surface is almost entirely covered with the white ferrite. As the carbon content raises pearlite begins to show in the form of separated pearlite islands in a ferrite matrix, as shown in Fig. 2. Further increases in the carbon content make these dark masses spread until they become connected and appear in streaks similar to the formation illustrated by Fig. 3. When the carbon content has reached 0.85 per cent. these dark patches nearly cover the entire surface, and the metal has the appearance of that shown in Fig. 4.

The pearlite is an intimate mixture of ferrite and cementite, the latter of which begins to appear after the carbon content has passed the point represented by 0.85 per cent. It consists of 32 parts of ferrite to 5 of cementite, which gives it the appearance of mother of pearl, from which it derives its name. It exists either as alternate plates of ferrite and cementite, or in a granular formation composed of intermingling grains of ferrite and cementite. When the pearlite is predominant the metal has the finest cyrstalline structure of any of the carbon steels, and it is the strongest. By proper heat treating this metal can be given a greater degree of combined hardness and toughness than any of the other steels. When thoroughly annealed a rod 1-8 inch in diameter can be tied into knots when cold without its cracking. This well indicates the combined toughness, ductility and strength to be found in this grade of steel.

Cementite is a carbide of iron that is expressed by the formula Fe_3C. Practically all of the carbon is present in this form, and it usually crystallizes in thin flat plates. It is the second constituent of importance in steel, and of itself contains 6.60 per cent. of carbon, which is about one-fifteenth of its

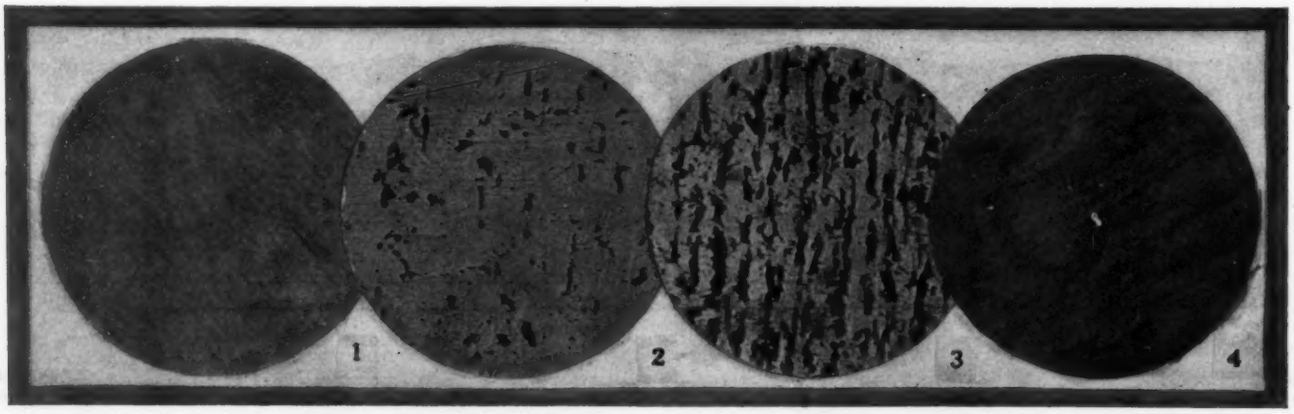


Fig. 1—Ferrite predominating in a very low carbon steel at 350 diameters

Fig. 2—Ferrite matrix with separated pearlite islands at 350 diameters

Fig. 3—Ferrite, showing white and pearlite as the black in the field at 350 diameters

Fig. 4—Pearlite predominating as in .85 carbon steel at 350 diameters

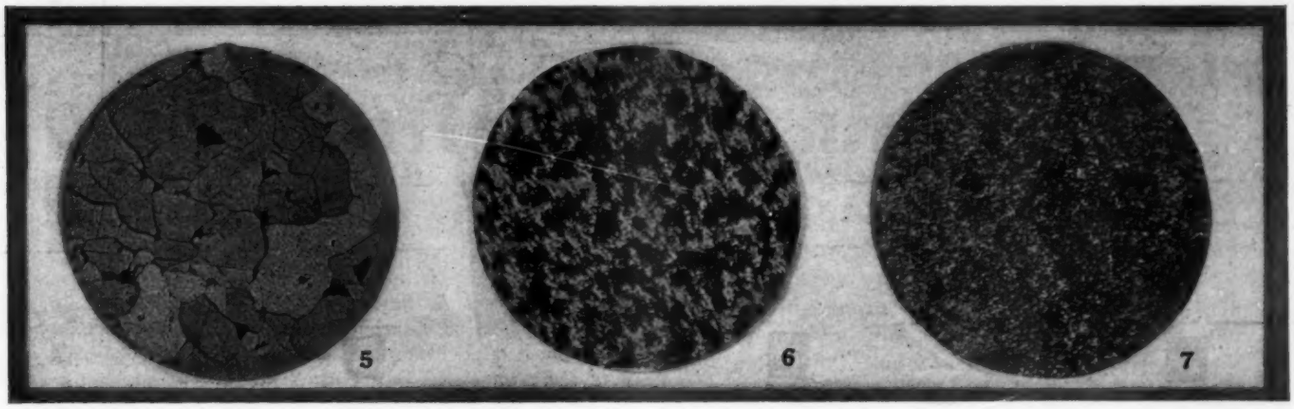


Fig. 5—Pearlite with a very thin, continuous cementite skeleton at 350 diameters

Fig. 6—Pearlite, showing white and cementite as the black in the field at 350 diameters

Fig. 7—Pearlite and cementite in a chrome-vanadium steel at 350 diameters

mass. Its more important characteristics are its great hardness, brittleness, and consequently lack of strength. It first takes the form of a continuous skeleton framework, as shown in the pearlite matrix in Fig. 5. As the carbon content increases this skeleton develops into a mass of patches that are connected with one another, as shown in Fig. 6, where its area is about equal to that of the pearlite.

The structure indicated by these microphotographs is only seen when the steel has been thoroughly annealed. When the metal is heated to higher temperatures and quenched, as in hardening, these constituents are altered. If we take a steel consisting entirely of pearlite and heat it to 1,350 degrees F. the pearlite disappears and polyhedral crystals that form a homogeneous white substance called austenite make their appearance. When quenched at different temperatures martensite, sorbite and troostite become constituents of the metal. These will be discussed later in an article on "Hardening."

To form definite conclusions on the characteristics of the metal from these structures it would be necessary to know the chemical composition of the metal, as some of the ingredients or alloying materials might alter their appearance. As an instance, Fig. 7 shows a chrome-vanadium steel that is in the same annealed state as the carbon steels shown in Fig. 6. As will be seen, the cementite and pearlite are practically in the same proportions, but the much finer grain shown in the chrome-vanadium steel might be misleading. The chromium might also change the result given by the carbon content. The etching material is important, as one will make the ferrite, pearlite or cementite show black and another will make them appear white.

Austrian Trucks Subsidized

Considering the advantages offered by the automobile to the army from the transportation point of view, the Austrian Government has decided to subsidize the private purchasers of motor trucks of a suitable type, with a view to using these modern conveyances in an emergency and to avoid the necessity of having its army crawl on its belly in case of war.

VIENNA, APRIL 18—The Austro-Hungarian army administration has passed an allowance of several hundred thousand dollars for subsidies to be extended to the purchasers of self-propelled trucks, in order to encourage the business men of this country to take more rapidly to the new means of transportation, the object being not alone the fostering of the automobile industry, but the accumulation of a stock of freight automobiles which might be used should an international complication arise. It was some years ago that Germany, Japan and France introduced this measure, and as the Balkan war scare seems to be never-ending, and something must be done to be prepared for a possible conflict, the Austrian Government has decided that an investment such as the present one is the best that could be made at this time.

The type to be subsidized is a five-ton truck (no special make being favored) in combination with another freight wagon to be attached thereto. The average price of such a freight unit is approximately $5,000, and the Government has allowed a subsidy of $800 to be paid to the purchaser of such a freight train, with $200 to be paid as an annual premium on the truck during the following lustrum.

A similar measure taken by the German Government resulted in the operation of more than 500 subsidized trucks at the end of last year, most of these automobiles being used by breweries, express companies, farmers and brick makers. A similar success is looked for in this country, and the type of chassis selected by the army administration is one that may be used for the type of omnibus now being operated in several large cities.

In order to make the type available for many applications, a high gear ratio has been selected. Among the specifications stated by the administration are a chassis weight of 6,000 pounds, a motor output of 35-horsepower, 134 inches wheelbase, 55 inches tread, solid rubber tires 32 3-4 x 4 3-4 front and 42 x 5 3-4 rear. Four speeds forward and one reverse are required, as well as two brakes. The specifications for the attachment have not yet been published. The useful body area must be 112 inches in length by 64 inches in width, and board walls 24 inches high must be provided. The second wagon must have an area of 180 by 76 inches, walls to be of same height. The maximum speed of a unit is 14 miles per hour.

The subsidized trucks may be called in for yearly maneuvers for from two to three weeks, and a compensation of $8 a day is paid to the owner in such a case. Besides this one obligation there is no inconvenience of any kind connected with the ownership and operation of a subsidized truck. Moreover, no trucks which have to do the bulk of their work during a specific season will be required to maneuver during that time, so that the subsidy means hardly anything but a benefit to the farmer and business man. In urging the population to avail themselves of the new privilege the Government will of necessity call their special attention to the superiority of the automobile over the horse and thereby help the automobile industry a good deal.

The engineers who have devised this type of truck have always kept the specific road conditions of the country in view, and it is for this reason that the Government hopes a more general introduction of the self-propelled vehicle will be the result of its endeavor.

FITTING OF KEYS IS WORK FOR AN EXPERT—Keys will not hold unless they are fitted very tight. Put a boy on some other job, but put a machinist of considerable experience on the key-fitting. A loose flywheel is not a pleasant thing to be shipmates with in a swamp, miles from home.

Systematic Trouble Hunting

Taking Advantage of the Process of Elimination

Having presented fifteen specific cases, it is the purpose here to continue on citing other cases, it being true that each case represents a fundamental basis of trouble hunting, and by classifying the known quantities make a search for the trouble that is to be found among the unknown quantities. It is recommended that the trouble hunter proceed systematically, making it a point to transfer the unknown quantities to the column of known quantities as fast as investigation affords the desired information, so that by a process of elimination the trouble may be found.

Case No. 16—Motor Runs Normally

If noise is unduly present;
If the motor makes noise with the car standing still;
If the car makes noise and the motor is silent;
If the performance is silent during direct gear work;
If the noise is confined to low-gear work.

It Stands to Reason That

The gears are not running on the pitch line;
The gears are not properly shaped;
The pitch line velocity of the gears is too high;
The gear teeth are bunged up;
The gear shafts are loose in bearings;
The oil leaks out (planetary gear);
The transmission case is full of grit;
The end-shake of the shafts is excessive, causing interference.

Case No. 17—Motor Runs Normally

If there is a noticeable amount of noise;
If the car standing still is noisy when the motor is running silently;
If the car in motion is noisy when the motor is running silently;
If the car makes a noise running under all conditions of gear changing.

It Stands to Reason That

The relations of the chassis parts are not good; there is lost motion between them;
The bevel gears are not properly adjusted;
The bevel gears are not properly shaped;
The bevel gears are not lubricated;
The differential gears are out of order;
The live rear axle has lost motion;
The universal joints are worn;
The universal joints want lubricating;
The rear-wheel bearings are loose;
The front-wheel knuckle has lost motion;
The front-wheel bearings are loose;
The sprocket wheels are worn (chain drive);
The sprocket chains are stretched (chain drive);
The sprockets are running slack;
The radius rods are loose in their joints;
The distance rod fastenings are insecure;
The propeller shaft is twisted;
The jackshaft is twisted;
The spring shackles are loose;
The steering gear linkages are loose in their bearings;
The steering gear is worn out or requires adjustment;
The mudguards are flapping, and the fastenings require fixing:
The bonnet is not being properly held down;
The sod-apron is not secure in its fastening;
The small bearings throughout the chassis are crying for oil;
The body is working on the chassis frame;
The ball or roller bearings are not securely locked;
The spring clips require tightening up;
The shock absorbers are adrift;
The tools in the tool-box are jumping about;
The lamp brackets require tightening up;
The windshield is not securely fastened to the dash;
The doors of the body are rattling;
The glass in the windows of the body is loose in the sashes;
The jack is bouncing around on the tonneau floor.

Case No. 18—Car Runs Normally

If there are undue indications of depreciation;
If the motor is sweet-running;
If the transmission performs silently;
If the differential gear is working all right;
If the live rear axle is silent and satisfactory;
If the propeller shaft is doing good work;
If the sprocket wheels and chains are working all right:
If the road wheels are up to the need;
If the steering gear is performing its proper function;
If the sliding gears answer every purpose;
If the water-cooling system serves its end;
If the brakes are powerful and dependable;
If the lubrication is profuse and adequate;
If the ignition system works all right;
If protection from dust and the elements is complete;
If the tire equipment is good and satisfactory;
If the carbureter interprets the gasoline properly;
If there is gasoline in the tank;
If the spring suspension is flexible and dependable;
If the lighting equipment is all that could be desired;
If the clutch is properly rated;
If all of the bearings are doing good work;
If the chassis frame is rigid and strong;
If the universal joints are above criticism;
If the ignition battery is up to capacity and working;
If the tool-kit includes a good selection of tools.

It Stands to Reason That

The lubricating oil, if it has an acid reaction, will etch the polished surfaces of the bearings;
The decarbonizer, if it has etching properties, will attack the polished surfaces of the cylinders of the motor;
The gasoline, if it is "doped," may attack the cylinder surfaces;
The tires will deteriorate if products of combustion are used to inflate them;
The tires will rot if the little wounds are not healed up;
The leather facing of the clutch will burn if the clutch is permitted to slip;
The fiber facings on the brake-bands will char if the brakes are unduly employed;
The sprocket chains will wear out if they are not kept lubricated;

THE transmission gear will become noisy if the grease is not replenished;
THE bearings will wear out if the lubricating oil is not replenished before it becomes stale;
THE sliding gears will be bunged up if the chauffeur is a careless shifter;
THE chassis springs will deteriorate if they are not lubricated occasionally;
THE crankshaft will be destroyed if the motor is raced;
THE cylinders will grow a coat of carbon on excess lubrication;
THE cylinders will quickly carbonize if too much gasoline is used;
THE motor will unduly labor if the mixture of air and gasoline is inappropriate;
THE car will be unduly racked if the rate of travel is first high and then low speed, alternating between the stress of power and the hasty application of brakes;
THE metal of which the parts are made will deteriorate under conditions of excess shock, due to high speed or bad roads;
THE delicate finish of the body will depart if mud is allowed to dry upon its surfaces;
THE tints of the finish will become dull if the automobile is stored in a dark place;
THE pigments in the body finish will change color if the automobile is stored where the light is direct and fierce;
THE automobile will show a high rate of depreciation if it is speeded around curves;
THE tires will give out quickly if foreign substances creep in when the tubes are inserted;
THE tires will not last if they are not lubricated by means of soapstone, or other suitable material, to prevent the tubes from adhering to the cases;
THE tires will give out if they are unduly flexed, which will be true if they are not properly inflated;
THE rate of depreciation will be multiplied by four if the speed of the car is doubled; the most satisfactory service will result from a moderate speed at a constant rate of travel.

American Cars in Russia

Prominent member of Imperial Automobile Club of St. Petersburg asserts that cars built in this country are better suited to the conditions as they obtain in Russia than are any other foreign makes.

THREE American manufacturing concerns have opened agencies in St. Petersburg, Russia, for the sale of automobiles, while one of the houses has established agencies in other Russian cities. High-priced American-made automobiles no doubt would find favor in St. Petersburg, provided that the manufacturers' terms of sale were to conform to the rules of credit which obtain in that country. Low-priced cars might get a foothold if their quality were sufficient to meet the competition of those made by English, French and German manufacturers. M. Kuznetzow, who is a member of the Imperial Automobile Club of St. Petersburg, has been lecturing before the Engineers' Club, which is allied with the Ministry of Ways of Communications, of which Ministry M. Kuznetzow is also a member. Taking American and English automobiles for his subject, he illustrated his lecture with a series of stereopticon slides, especially of American-built cars. He emphasized the excellence of the quality of steel used in their construction, as well as discussing the question of speed and endurance tests, the lowering of prices as the result of wholesale manufacturing and excellent business organization and not on account of detrimentally cheap material. The lecturer also spoke of the American roads, comparing them with Russia's highways more than any resemblance that they bear to Western European roads. He produced stereopticon views of some muddy roads in America, characterizing them as being typical Russian highways. He argued that the cheaper grade of American-made cars were the best adapted to Russian use. He then went back and made it clear that American-manufactured automobiles are better suited to conditions in Russia than other foreign makes; also that the cheap price of American-made machines is not due to any inferior quality of material in their composition.

The Acer Dynamometer

A Quick Means of Testing the Power of a Motor*

By the aid of the instrument here described it is possible to ascertain the brake horsepower of any gasoline motor fitted in a chassis without disturbing it. The apparatus is placed under the flywheel of the motor and the results can be immediately read without calculation, as they are marked off on a chart that forms a part of the outfit.

A PORTABLE dynamometer for testing the actual b.h.p. of an automobile engine without removing the latter from the chassis, and also without any elaborate calculations, is yet another addition to the up-to-date apparatus now available for the repair-shop and the motor garage.

It is merely necessary to place this instrument under the flywheel. Then, on depressing a lever so that the dynamometer is brought into frictional contact with the fly-wheel, the "pull" and speed are simultaneously recorded on a chart, a permanent record of the power developed by the engine being thereby obtained.

In construction and operation this device is quite simple, considering the part it has to play. It consists of a strong iron frame carrying a platform that slides on two rollers. This platform is connected to a strong spring, and is fitted with cork pads. In the centre of the cork pads is a vertical wheel, the top of which is flush with the surface of the former, so that both are in frictional contact with the flywheel of the engine. A centrifugal governor, which is connected to an arm carrying an ink pen, is fitted to the spindle of the wheel, so that according to the speed of the latter the pen is made to move further or less far across a drum carrying the chart.

The drum is connected to the sliding platform by a rack and pinion gear, and

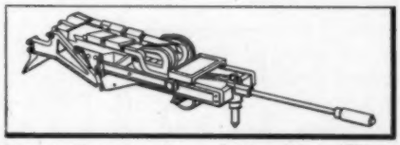


Fig. 1—General view of the Acer "Power Tester"

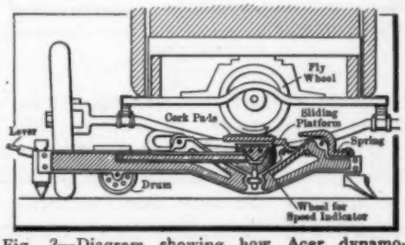


Fig. 2—Diagram showing how Acer dynamometer is installed under flywheel

*From *The Automotor*.

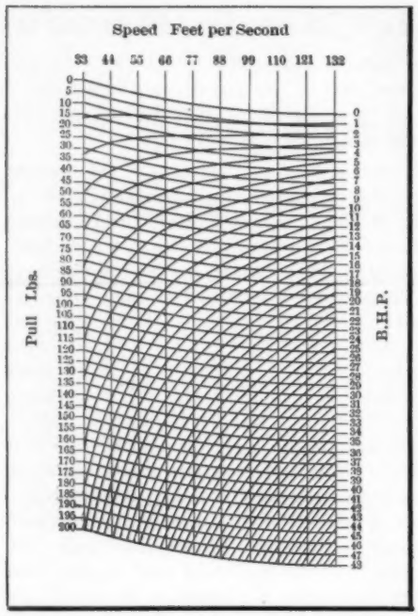


Fig. 3—The chart which is attached to the drum, and which records the torque and speed. Movement from left to right indicates the speed, while the torque and the B. H. P. can be ascertained at any point where the ink line intersects the curved lines engraved on the chart

is thus rotated through a certain amount in relationship to the movement of the platform. The b.h.p. can, therefore, be ascertained at any point where the line traced by the pen intersects the lines engraved on the chart—which is illustrated by the accompanying diagram—and no complicated calculation whatever is required. The dynamometer must be placed under the flywheel, so that the direction of rotation of the latter tends to pull the platform in the direction which puts the spring in tension.

An obvious advantage with this instrument is the elimination of "personal error." At first sight it might be thought that allowances would have to be made for different diameters of flywheels. But this is automatically compensated for, because the lineal speed of any periphery in feet per second is ascertained by the speed indicator, and the frictional contact of the cork pads —which indicates the tangential pull—takes place at the same radius.

Digest of Foreign Papers

Matter that is taken from foreign publications, selected for its value to the engineer, allowing that ideas that are well known in American practice will scarcely be worth recording in view of the value of space.

IN a previous article on the subject of magnetos a writer in *La Vie Automobile* discussed the present practice to set the magneto with a fixed advance, and while admitting that there were some advantages in such a setting, as, for example, that it did away with one lever, nevertheless in large motors and equally so with very small ones, there was a difficulty in starting the former and want of suppleness in the latter with the magneto uncontrolled. In some cars it is necessary to have some means of retarding the spark for starting, which means that two firing points are necessary. In order to effect this the method shown in Fig. 2, the invention of M. Malivert, was suggested. This is a method of simultaneously controlling the magneto and carbureter, at the same time facilitating the starting properties and automatically opening the gas passage by the starting crank. It is well known that all good carbureters claim an easy-starting ability with the throttle closed, but there is no doubt that carbureters in general start better with the throttle slightly open. The disposition of M. Malivert's attachment not only retards the magneto to the dead center point for starting, but produces an opening in the carbureter, the magneto and the throttle slowly dropping back to their normal position, that is fixed point of advance in the first place and retarded in the second, during which time the motor attains its slow speed of rotation running empty.

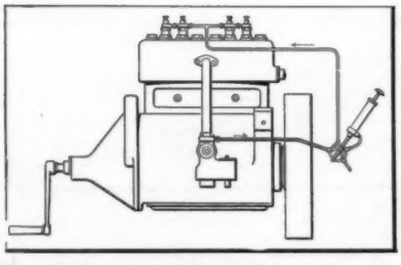


Fig. 1—Method of fitting Malivert connections to spark plugs

There are magnetos on the market in which the variation of the advance is obtained by oscillating motion of the interrupter. Others effect this end while obtaining a full degree of advance without altering the position of the induction poles. But the only type that gives an identical spark, no matter what

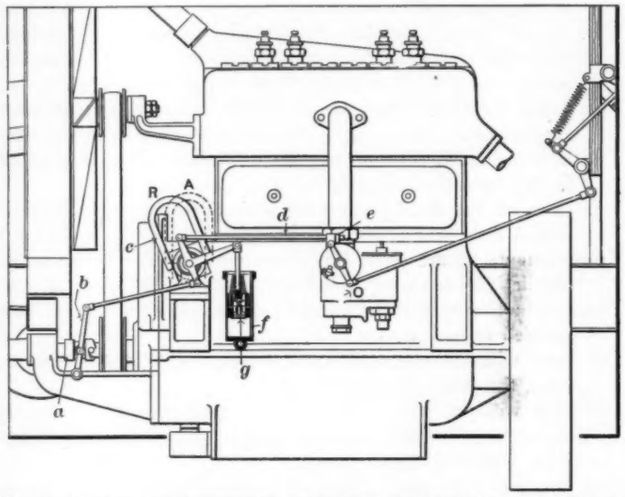


Fig. 2—Showing the arrangement of magneto and carbureter according to M. Malivert's suggestions

the amount of the degrees of advance may be, is that where the magnetic field is capable of being moved.

How this effect can be obtained is a matter to be explained, and it is indeed very simple. By pushing the starting crank in Fig. 2 the tongued joint A forces the lever B back, which in turn forces the magneto into a retarded position. During the same operation the carbureter throttle is slightly opened by the movement of the rod D through the lever E. At this moment the spring in the dash pot F is tightened and the instant the starting crank is released this spring causes all the parts to return to their normal position slowly, and as the hole G is very small, the motor starts easily and takes up its normal running without any jerk.

It is understood that the attachment to the accelerator does not in any way interfere with the starting-crank lever, and if necessary another method of attachment to suit the particular car than that shown in the illustration can be used, provided it

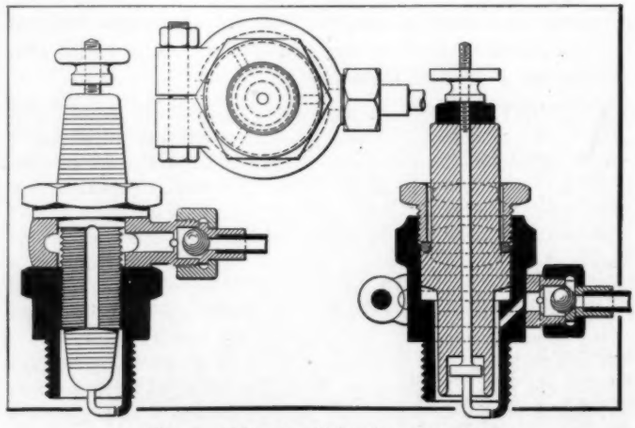


Fig. 3—Malivert self-cleaning spark plug

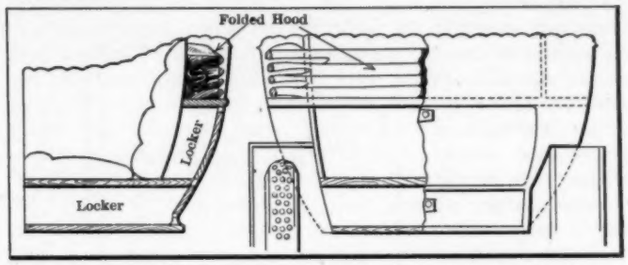


Fig. 4—Rear and side view of a body, showing the hood folded into a separate back panel

can be attached to the existing carbureter connections. The same inventor has produced a new spark plug that has automatic cleaning properties. Intended primarily for aviation motors, it can be used just as well for automobile motors. The advantages claimed are that it is self-cooling and self-cleaning during the time the motor is running.

This is obtained by causing an explosive mixture to circulate around the insulation and the electrode, which carries with it a more rapid propagation of the flame and should increase the efficiency of a motor when placed in the most advantageous position. If the energy of the spark is not taken into consideration with the rich mixtures that we are in the habit of using, and if the utility of the double ignition is mythical in that it is better to expend all the electrical energy available at one point carefully chosen, it is no less true that the choice of the position of the plug has a considerable relative importance.

A plug of the type shown in Fig. 3 effects this, as it causes a rapid and clean combustion. It is obtained by attaching the spark plug with a collar with suitable perforation to the intake manifold. A small ball acts as an automatic intake valve, and only permits communication between the plug and the carbureter during the intake stroke. This permits a certain amount

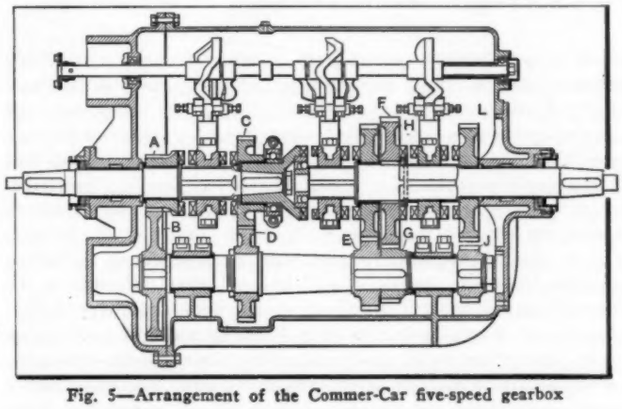


Fig. 5—Arrangement of the Commer-Car five-speed gearbox

of carbureted gas to circulate around the interior of the plug, lapping the insulation, driving out the burnt gas and dissolving the incrustations and cooling the electrodes, thereby avoiding preignition and maintaining around the latter a priming of pure gas ready to explode. With an addition of a pump connected in the manner shown in Fig. 1 it is possible to force carbureted gas through the plug and thereby clean it. It is possible to use the apparatus as a self-starter in the case of a four or six-cylinder motor where the ignition was arranged so that the motor would start off on contact. There does not seem any necessity to alter the original spark plugs, as most plugs are suitable for the fixing of such a collar as shown in Fig. 3.

A New Gearbox—A gearbox which has but recently been introduced is that now fitted by Commercial Cars, Ltd., to five-ton and six-ton models. We reproduce a line drawing of this gearbox; it is designed to provide for five forward speeds and one reverse, and is the first of its type which has been designed for petrol wagons. It is built on the lines of the usual three-speed "Commer-Car" gearbox, and, as a matter of fact, the only points of difference between the five-speed box and the three-speed box are a slight lengthening of the box, and the introduction of one extra sliding claw clutch and one more pair of gear wheels. These wheels, in the line drawing, are lettered G and D, and the extra sliding clutch is that which may be caused to mesh either with the wheel A or C. If referring to the drawing, it will be seen that the various speed ratios are obtained by engaging one or more pairs of claws by which the wheels may be locked to their respective shafts, as follow: First, from the primary shaft, through the gear wheels A and B to the layshaft, and thence to the tailshaft through the gears G and H; second, from the primary shaft through the gears A

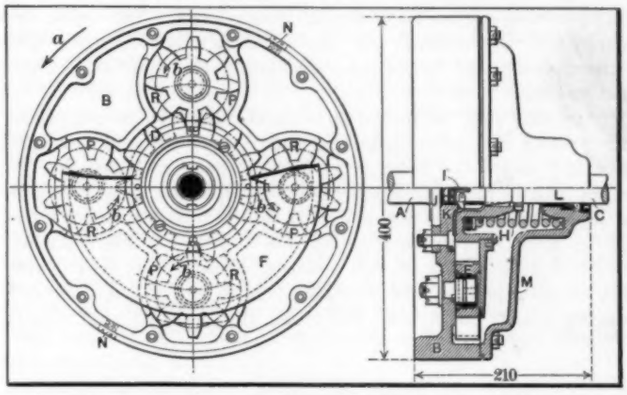


Fig. 6—Flersheim progressive centrifugal hydraulic clutch

and B to the layshaft, and thence through the gears E and F to the tailshaft; third, from the primary shaft through the gears C and D to the layshaft, and thence through the gears G and H to the tailshaft; fourth, from the primary shaft through the gears C and D to the layshaft, and thence through the gears E and F to the tailshaft; fifth, a direct drive is obtained by sliding the center coupling so that it is brought into mesh with a clutch piece, which is keyed to the end of the primary shaft. For the reverse speed, the drive is transmitted through the gears A and B to the layshaft, and thence from the pinion J through an intermediary pinion K to the gear-wheel L.—*The Commercial Motor.*

Hydraulic Clutch—The clutch here described works on the pump principle, or, rather, is composed of a series of gearwheel pumps which can be filled more or less in order to engage or declutch. The heat generated by the slipping that takes place inside the outfit is carried off by means of the motion of the oil therein contained, and is thus readily dispersed, the temperature not rising perceptibly.

The apparatus, which is shown in Fig. 6, is constructed as follows: The flywheel of the motor B carries four axes, situated respectively at 90 degrees to one another, on which run four satellite pinions E, which are made of fibre; these are in constant mesh with the central pinion D. This latter is keyed to the gear box shaft C, which in turn is supported by the two bushes K and L. The bush L forms a stuffing-box or gland and is made in such a manner as to prevent the oil from leaking out

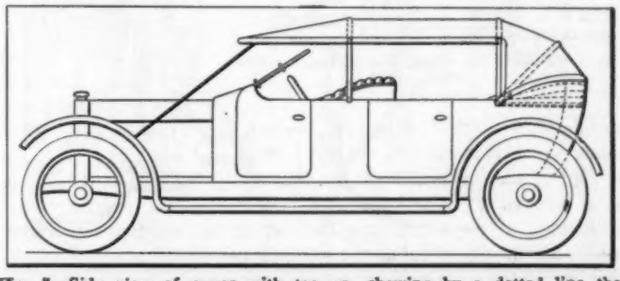


Fig. 7—Side view of a car with top up, showing by a dotted line the position it falls when folded

while the car is standing still. While the motor is running the oil is thrown by centrifugal force through small channels on the walls of the cover, and consequently never reaches the level of the packing gland, which prevents any oil from escaping. On account of this bath of oil all the parts run without shocks and without wear. The central pinion D connected with the plate F, which has a lateral motion and can either be in contact with the satellite pinions E or entirely separated from them. During this operation, however, the gears E and D always remain in mesh.

Each of the satellite pinions, which are made of fiber to minimize noise, rotates in a chamber closed on all sides except the lateral openings, where one of the surfaces is either closed or opened by the plate F. There is a large cavity open at the extremities of the apparatus through which the pumps suck. A fairly strong spring H gives the clutch effect. The entire apparatus is equilibrated and has no longitudinal thrust. The action is obtained by simply withdrawing the shaft C to effect declutching.

Supposing that the motor turns in the direction of the arrow, the pinions E carried around by their respective axes have primarily a motion of rotation around the principal axis, and another around themselves, and presuming that the apparatus is in a declutched position the pinion D will remain stationary. But if the plate F is pressed against the satellites E the space between the two teeth R fills with oil because the plate leaves the exterior parts of the satellites free to run in the oil inside the apparatus, and it is the space thus created that causes the pumps to start sucking. The oil thus carried in by the pumps is carried around by the teeth of each pinion until the teeth of the central pinion bar its passage. It therefore cannot pass. On the side P, however, there is a space formed when the two teeth, one of the pinion D and the other of the satellites E, are no longer in contact and the corresponding depression will oppose the rotation of the satellites. Thus these will not be able to turn around themselves and the whole will form a solid block; there is a slight slipping owing to leakages in the pumps, but this is very small and does not amount to more than 2 per cent. with naphtha oil and one per cent. with castor oil.

If the plate is slightly disengaged the leakages will increase, but not more than the flow, and the clutch will slip without being entirely disconnected. If the plate is entirely withdrawn the leakages will equal the flow and there will no longer be any adhesion.—From *La Vie Automobile.*

Encased Tops—The drawings of the hood seen in Figs. 4 and 7 appeared in the *Autocar.* The back panel of the car is in reality double, the upper portion forming a U-shaped channel in which the top may rest snugly stowed away out of sight, and the lower portion a locker for stowing spares and tools or maybe a suit case. The increased overhang of the body is not unpleasant in appearance—at any rate not so unpleasant as an overhanging top. Neither is the increased width, as both this and the depth are amply compensated for by the improved appearance and neatness of the bodywork owing to the hood being stowed away out of sight when folded.

What Foreign Designers Are Doing

New Ideas in Motor Engineering, Showing Variety

Every day seems to bring with it some new idea in automobile construction, in the shape of a gasoline motor along novel or extended lines, and three of these are here described. In the majority of cases designers are working along lines that would seem to have for their object the suppression of the poppet valve.

Double-Acting Gasoline Motor—Up to recently the chief difficulty in the production of a two-stroke motor has been to obtain a satisfactory scavenging of the cylinder after each working stroke. The majority of engines built have been arranged either to compress the charge in the crank-case, or else the cylinder is supplied with gas from a pump, and in both cases the exhaust gases escape by their own pressure or that of the incoming charge. While of the two-cycle type, this motor works on the Otto principle, combining the complete scavenging action of the latter with the flexibility of the former.

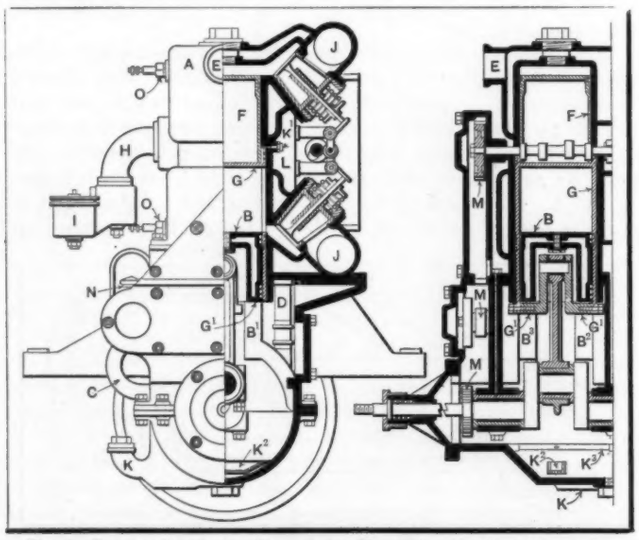


Fig. 1—Part sectional elevation of the Thrutchley double-acting engine

From the illustrations, which show part sectional elevations of a two-cylinder engine, it will be seen that the end of the cylinder nearest the crank case is closed by a stationary water-cooled head B, which is similar in form to a piston, and allows splash lubrication to be used as in the ordinary open-end cylinder; it also insures that after each firing stroke complete scavenging is obtained, the piston sweeping out the exhaust as thoroughly as in the case of a four-stroke engine.

Each cylinder is provided with a piston, which is made in two parts, F G, the upper part drawing in and compressing gas in the upper combustion chamber in the ordinary way, while the lower half slides over the stationary head, forming a second combustion chamber inside the piston. The upper half of the cylinder being of the same bore as the lower half of the piston, an equal explosion is obtained in both combustion chambers. Attached to the piston are two small arms which carry the gudgeon pin under the stationary head, from which power is transmitted by means of an ordinary connecting rod to the crankshaft.

The valves are of the poppet type, and are set at an angle of 45 degrees on one side of the engine, being operated by rockers from a single camshaft situated about half way up the side of the cylinders, driven by silent chains working on the chain wheels M. The lower valves communicate with the lower combustion chamber by means of ports in the walls of the piston.

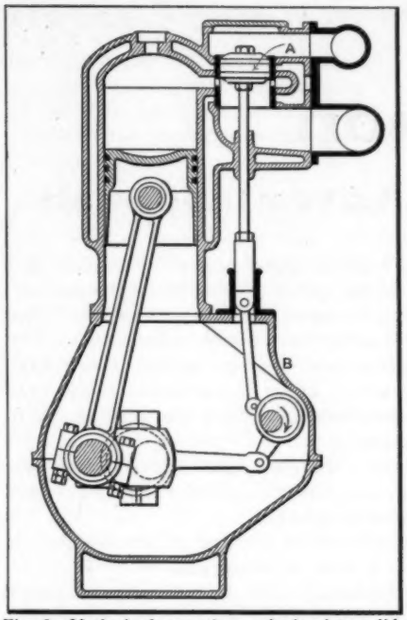


Fig. 2—Method of operating a single piston slide valve

The ports are arranged to pass easily over the rings in the stationary head, while the valves may be quickly withdrawn for inspection by removing the rockers and covers.

The inlet valves are connected to a single passage which passes between the cylinders to the carbureter, which is situated on the opposite side of the engine, whilst the upper and lower exhaust pipes lead into a common expansion box at the rear.

The sparking plugs are placed on the opposite side of the cylinder to the valves, those firing the charges in the lower combustion chamber being exposed by small ports in the lower halves of the pistons.

A two-cylinder engine working on this principle gives one explosion to each stroke of the pistons. The cycle of operations, with cranks set 180 degrees, may be arranged as follows:

Cylinder A.		Cylinder B.	
Upper.	Suction.	Exhaust	
Lower.	Compression.	Explosion.	= 1 Rev.
Upper.	Compression.	Suction.	
Lower.	Explosion.	Exhaust.	
Upper.	Explosion.	Compression	
Lower.	Exhaust	Suction	= 1 Rev.
Upper.	Exhaust	Explosion	
Lower	Suction.	Compression.	

It will be noticed that the head B has five piston rings which expand against the inner walls of the piston, whilst the piston itself is provided with nine inner rings, three at the top, three half way down, and three at the bottom, making fourteen rings in all per cylinder; so that a two-cylinder engine, as shown in the drawings, will contain twenty-eight piston rings. An engine built on the ordinary four-cycle principle, and designed to give the same number of impulse strokes, usually contains sixteen rings, but the twelve extra rings can hardly be considered against the running of the engine, as it is generally understood that a ring, correctly fitted to a piston working in a well-ground cylinder and properly lubricated, causes very little friction.

The stationary head, which is cast in one piece with the center of the crankcase, is supported by four arms, which provide means for circulating water through the head. The water circulation is as follows: From the radiator the water is pumped to one of the arms supporting the stationary head, through which it ascends to the head, and from there, by means of another supporting arm, to a pipe by which it enters the lower water jackets on the cylinder at the valve side; then, rising through the upper jackets, it circulates round the upper valves and cylinder head, from which it passes back to the radiator.

Lubrication for the big ends, gudgeon pins, heads and lower halves of pistons is obtained by oil from troughs, splashed up by scoops on the big ends, whilst the crankshaft bearings are supplied direct from the pump. Oil is carried up by pipes to the upper halves of the pistons, and any surplus oil collecting in the spaces left between the upper and lower bores of the cylinders when the pistons are on the down strokes is pressed out by the tops of the lower halves of the pistons on the next upward strokes into pipes which lead the oil back to the pump in the crankcase. The rings at the top of the lower halves of the pistons act as scrapers, and prevent oil from getting down into the lower bore of the cylinder.—*Motor-Car Journal.*

Piston Valve Motor—Fig. 2 shows the method of operating a piston valve of the Berry & Mann type. The system of operation is very simple, and is a step from the conventional poppet valve to the slide valve. The method of operating the push rod is clearly shown and it eliminates all springs, being entirely positive in its action. It has the advantage of reducing the number of parts usually found in slide valve motors and obviates all pocketing of the gases during the explosion stroke. —*La Vie Automobile.*

A New Gasoline Motor—A novel type of internal combustion engine has been developed by the Dome Valve Gas Engine Company, of London and Birmingham, England. Its fuel is petrol, petroleum, crude oil or various grades of gas, working on the four-stroke principle (Fig. 3).

The departure from previous practice is found in the valves, which are made in the shape of a pair of wide concentric hollow domes. The domes have horizontal ports and are adapted to slide to and fro perpendicularly for a short distance over the outside surface of the cylinder head. These domes are the valves working noiselessly in oil by a positive drive and encased within an oil-containing dome-shaped cover provided with lateral inlet and exhaust ports that are opposite similar ports in the cylinder head. Notwithstanding their very large port area, the dome valves are light in weight and they have the new feature of being automatically balanced by the gas pressure in combination with mechanical balance.

Washable Varnish for Highly Polished Metals

A varnish which keeps metals highly reflective and which applied to the parabolic surfaces of projectors at lighthouses or in automobile lamps saves both work and efficiency, has been produced and marketed under the name of "camt." It is obtained by dissolving a gelatinous lacquer at high temperature in amylacetic ether with the addition of a siccative, and becomes very hard and quite impervious to water. It is applied cold without any preparation and dries in a few hours, forming an exceedingly thin and absolutely invisible film through which the metal shines with all the polish that has been imparted to it. While this new varnish may be washed with impunity it will not stand much rubbing, and is therefore of no great value for metallic automobile parts which are constantly subject to handling.

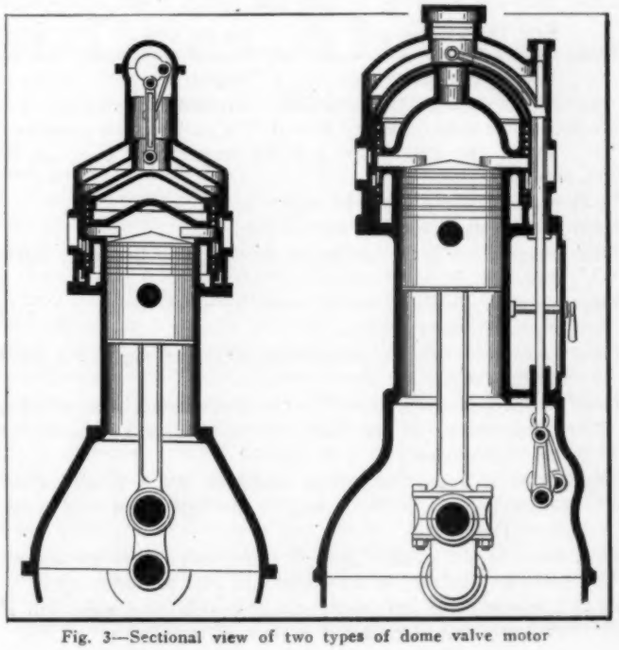


Fig. 3—Sectional view of two types of dome valve motor

It Stands to Reason

Exercising the Power of Reasoning Advantageously

THAT a well-nourished automobile will lavish good service on its fortunate owner.

THAT a colorless performer, automobilewise, reeks with the earmarks of neglect on the part of a slovenly driver.

THAT the pendulum swings through its arc, measuring the distance from the sublime to the ridiculous—this is the condition that obtains when a good automobile is placed in the keeping of a bacchanalian.

THAT a balbucinator of a motor may be the loser of its soft rhythmic note in consequence of failure to feed it with oil.

THAT the ribaldry of the conversation that some motors carry on is a reflection on the bringing-up that they get—a well-behaved motor of good family shows its quality every day of its life.

THAT the motor which rigadoons but poorly takes the owner of the car as its partner.

THAT the Romanesque style of architecture for a country residence is limited in scope—it makes a miserable runabout.

THAT patience goes on a vacation when a miserere takes up its abode in the gearbox—noise is not an adorable mistress, and in an automobile it bites pleasure.

THAT the sweet poison of misused wine makes a chauffeur steer like a ward politician—it is a crooked course at best.

THAT a monastic life should be ideal for the man who calmly expresses his appreciation of the good qualities that he fails to find in a used automobile after he takes title to the same.

THAT the monotony of successful performance of a good automobile can be shattered by the simple expedient of using poor lubricating oil for a few hours or a day at the outside.

THAT morality is capable of demonstration, and is proven when an automobile reflects the rectitude of its maker.

THAT sales are not made by men who preach a sermon—present cold facts briefly.

THAT money moves into a new abode when a prospective allows the salesman to tell a "human interest" story—if the subject is the automobile, why not stick to it?

THAT a motor puts on a wry face if it is gorged with gasoline—adjust the carbureter and the motor will compose its countenance.

THAT a mum motor saves its maker much talk.

THAT a mutable tire has a far stretch.

THAT stridulation is the indication of departing life in an automobile.

THAT a subnuvolar automobile owes its natal characteristic to its poor construction.

THAT an hour devoted to necessities paves the way for a week of delight.

THAT the neolithic era should not be perpetuated in automobile construction—let the stone age remain as a remnant of an obscure past.

THAT straw is a poor structural material, but a single inharmonious idea in a car may be the last straw and break the camel's back.

THAT night is the opaque part of day—some lamps go out on cars by day and on the owners of cars at night—why?

THAT a motor pants before the car crowns a long, steep hill if the carbureter bleeds but a stint of gasoline.

THAT the buyer should make a "good stroke" of business and allow the stroke of the motor to remain uncontested.

THAT struggling ideas, each one of merit, let it be said, when lodged in a motor, clatter out of sheer discontent.

THAT the purchaser carries his eyes in another man's head when he requests advice of an acquaintance—is the head of the casual acquaintance so much the superior as to warrant the intrusion?

THAT automobiles so poorly designed that they will not perform properly should have a special name—why not designate them as cryptogamia?

THAT a display of verisimilitude on the part of the salesman is a sure sign that it is time to be on guard.

THAT a vermiculated automobile, even at half price, suggests the advisability of remembering another ancient adage: *Caveat emptor.*

Good Roads Benefit All

In so far as the increasing use of the automobile commercially brings about the building of good roads, in like proportion will the average citizen profit by reason of the lessened cost of the necessities of life, due to the farmer's ability to carry his wares direct to the consumer without being compelled to add the large freight charges to the selling price.

CONSIDERING the automobile and the fact that the road on which it rolls is in all fairness a legitimate part thereof, it must be remembered that there is such a thing as expending too much money upon the car proper and too little money upon the roadbed. There must be a point of natural balance between the expenditure that is to be made in the building of automobiles and the amount of money that should be put into road building in support of the broad issue, and the educational work that must go on for a long time to come will have to be so shaped as to teach the citizen who does not own and operate an automobile that he will be benefited to whatever extent he maintains his part of the road-building issue, it being true that in proportion as automobiles are permitted to transport products to the marts of commerce, the cost of the necessities of life to the average citizen will be favorably influenced. To a man who resides in a great city, and who is bent under the yoke of taxation, the lesson that must be learned comes as a task that he abhors, and yet his salvation lies in enthusiastically supporting the issues that will lead to the betterment of the roads, thus introducing such forms of transportation as will permit the farmer to choose the least costly of those available. It is not competition so much that reduces cost as it is the fear that competition if once introduced would permanently depress earnings. Railroad transportation, in the absence of automobile competition, would be as high as the law allows, and under such conditions in our form of government the law would be framed to suit the railroad magnate. With good roads, thus enabling the farmer to automobile his produce for a hundred miles with the same ease that he now goes ten miles, remembering that nine-tenths of all railroad charges are for terminal work in the large cities, it may readily be seen that the automobile coupled with good roads is an absolute guarantee of favorable freight rates, which is another way for saying that the plain citizen who fights for good roads is putting in his best licks, assuring the future of his own bread and butter.

Items From Foreign Lands

Interesting extracts, mainly from the United States Consular Reports, in which the status of the automobile in foreign parts is tersely set forth, and the prospects of extending the American market are called to the attention of those interested.

CANADA'S attitude toward American-made automobiles and tires is growing stronger and more favorable each day. American machines are being sought after. Orders for at least 2,400 automobiles have been placed within a short time. From five to forty cars of American make may be seen in cities of various sizes. The field for the American-made machine is expanding. There is also an increasing demand for tires made in the United States.

The Council of Lunneburg County, between Halifax and Yarmouth, in Nova Scotia, has just passed a law which forbids the running of automobiles anywhere within the boundary of the county on Wednesdays, Saturdays and Sundays. There are also other counties in Nova Scotia where motor cars are permitted to be run only three days in the week. At least one-third of the 150 automobiles in use in Nova Scotia are the property of persons who reside in Yarmouth County. Of the number fully 80 per cent. are American made. Four more motor cars have just been ordered by inhabitants of Yarmouth City.

One of the most unique sights having to do with automobiles is witnessed every Sunday in Mexico City. Two factors enter into the combination, the bull fight and the newspaper. The newspaper in this connection is the first afternoon sheet to be published in Latin-America, as it also is one of the first in the world to issue a regular Sunday afternoon edition. Even this would not be possible, so far as its circulation is concerned, if it were not for the number of automobiles that the circulation manager is able to call into requisition. Mexico City's Sunday sporting events include bull fights, cricket, golf, tennis, football and fox hunting. But the bull fight being the National divertisement, the newspapers play it up very heavy. In order to "cover" the assignment, the newspaper in question assigns a corps of six reporters, one man being detailed to each bull that is let into the ring. The moment that the first bull has been killed the reporter jumps into a waiting automobile and rushes his story to the newspaper office. The five remaining reporters emulate the example of the first man and within twenty minutes after the last bull has been slain the newspaper is on the street for sale, automobiles carrying the edition to the several points of distribution.

Australia has just begun to extend the field for the use of the motor car by adapting it for use in agricultural work, notably for ploughing, reaping, mowing grain and drawing wood. The number of automobiles in that far-off country for passenger, commercial and agricultural purposes is rapidly increasing.

Emperor William of Germany is the possessor of thirty automobiles, the lot comprising six motor luggage cars. His Majesty divides his machines among his fifty royal palaces, each residence having a modernly constructed garage. The benzine is confined in fireproof storage tanks, which are in turn built within fireproof rooms. Five of the Emperor's automobiles are maintained at Corfu, a palace to which he is very partial and to which he manages to pay annual visits.

Ireland just at the present time is favorably disposed toward American-made automobiles. As a result there is an increase in the demand for rubber tires of American manufacture, provided that they conform to the standard measurement. It is not out of place to call attention to the fact that rubber tires used on the European Continent, including Great Britain, are made according to the metric system of measurement. For this reason American-made tires, such as used in the United States, are not suitable for British or Continental European-made automobile wheels, and vice versa. At the same time, American-made tires bear the reputation abroad of outwearing those manufactured in Europe. An instance is pointed out in which a trial of 17,000 miles was put to the credit of an American-made tire on an automobile touring in Europe. In Ireland especially it is said that there would be a growing sale for tires made in America if the manufacturer would but conform to the European size standard. To supply the Irish trade the market could be entered the most effectively by establishing an agency in Belfast and accrediting a local firm there which conducts the leading garage to transact the business. This firm already has expressed a willingness to act as the local agent for an American-European agency, the head of which no doubt would obtain better results if it were established in London.

When the Tourist Goes Abroad

Automobiling on an Educational and Pleasure Basis

Turning the tables on those who have never been able to see the advantage of becoming acquainted with the people, the folklore, and the physical geography of their native land, and the islands adjacent thereto, showing by illustration how futile it is to girdle the globe in quest of scenic grandeur, and to meander the breadth of Europe, piercing Africa as a last resort, in quest of adventure. The examples as here presented of the scenes where touring may be looked upon as a profitable enterprise are within the confines of the land which met fame under the guise of "The brightest jewel in the Spanish Crown"—Cuba.

EXPERIENCED automobilists are learning how essential to success it is to tour in foreign lands under well-contrived conditions, utilizing a skilled touring master, and taking advantage of good company, all of which means that a party of automobilists, with a car equipment adequate for the need, may book ahead, arranging for hotel and other accommodations, and for the automobiles, for that matter, thus saving the cost of transporting their own cars and avoiding the possibility of damage to which cars are likely to fall heir in transportation on shipboard. When automobiles are transported over seas they have to be very carefully boxed at a cost not far from $100, and upon their arrival at a foreign port there are formalities to be complied with, and it is not unusual for the officials in such cases to take advantage of the unsophisticated. When all the costs are counted, not forgetting the troubles that arise in the interim, it is more than likely that there is profit in the idea of commissioning a seasoned touring master to arrange for the automobile transportation, doing all of the things that are necessary for the comfort and well-being of a party, remembering, of course, that this character of undertaking must be handled by a man of skill, otherwise the schedule will be lacking in flexibility, and the cost for extras in order to overcome objections will reach to the proportions of a pretty penny.

One of the difficulties that has been experienced heretofore

was founded on the over-ambition of those who undertook tours, and instead of seeing one land under favorable conditions they tried to cover a whole continent within a few months and failed. The same mistake can be made in undertaking to see the Antilles, and trying to tour through Cuba, Porto Rico, Jamaica, Barbados, and visit Panama, all within the space of a few short weeks. It would be more enterprising, and result in greater intellectual advantage, to initiate a series of tours, limiting a single trip to Cuba, for instance, or Porto Rico, for illustration, leaving Jamaica for a third undertaking, with a possible chance of including Barbados in the itinerary of this third trip. From the automobilist's point of view there is nothing in Panama.

The Swiss Exclude Motors

THE Swiss people dwelling within the Canton of Schwyz and along the roads of the Grisons, including the portion of beautiful territory lying between Landquart and Chur, have spoken —rather, they have voted—and with the result that automobiles are excluded from these sections of the Alps. Such an action on the part of the Swiss people does not indicate any sudden inspiration of an opposing nature. The spirit of hostility seems to have been born in them and, therefore, is the logical outcome of a determined will. They claim that their action is to prevent the possibility of accidents to pedestrians or to travelers riding in horse-drawn vehicles. The territory affected by the public vote includes the Bernia, Maloja and Splügen Passes in the Grisons; besides world-famed resorts, such as St. Moritz, Davos and Pontresina, the Maloja Lakes and the heavenly valley of the Engadine.

The resolution of the Swiss people came after years of effort on the part of the Federal and Cantonal Government and the Swiss Automobile Club, which bodies have been making strenuous effort and co-operating with automobilists to make their way into the Canton of the Grisons. Every argument was brought to bear, but the people refused to submit. Finally, automobilists tried to induce the Federal Council to take upon itself the authority to regulate

Fig. 1—Guines road, thirty miles from Havana

Fig. 2.—In Santa Clara Province—characteristic Cuban building
Fig. 3—Near Santiago de Cuba—filling in for a road
Fig. 4—Peace tree at San Juan Hill
Fig. 5—Avenue of Royal Palms

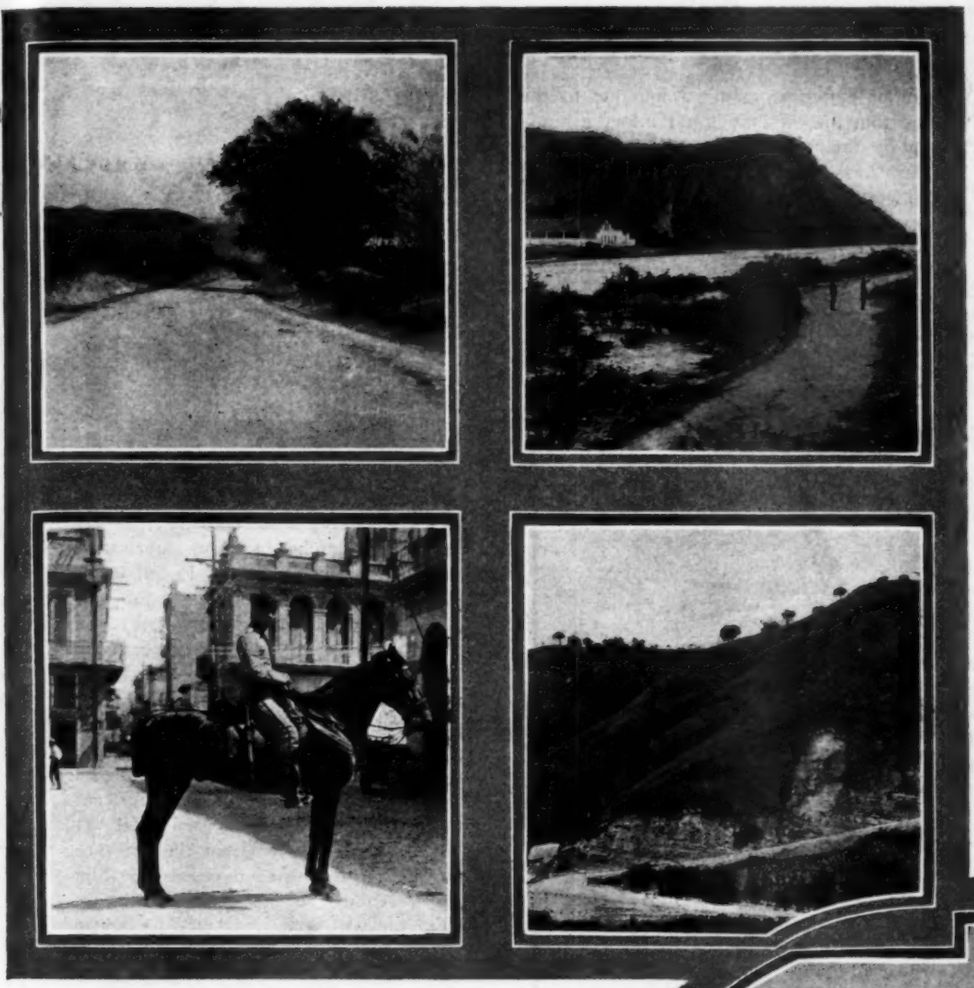


Fig. 6—Road from San Juan to El Caney
Fig. 7—Mounted Republican Guard—scene in Havana
Fig. 8—Matanzas—distance 120 miles from Havana
Fig. 9—In Santiago de Cuba—well constructed winding road

traffic in the Alps, but great opposition arose and the matter was subjected to the vote of the people. They won a victory, thus crushing out every future possibility of automobilists enjoying a spin over those portions of the Swiss Alps which come within the pale of restriction. The dead-line winds along very close to the zone of the great exposition which is to be held this Summer in Lucerne, and during which one of the attractive exhibits is to be that of motor cars. No automobile may attempt to travel over the roads which comprise the magnificent precipice along which threads the grand Axenstrasse, on the very brow overhanging Lake Lucerne. One of the arguments put up by the people of the Cantons was that the wheels of automobiles pulverize the macadam of the roads—mighty fine roads these in the Swiss Alps are, too—and that the dust flies into the fields, damaging the crops. Again, they said that visitors were made ill by the odor of the fumes of petrol.

T. C. A. Arranging Tour Routes

Despite the backward Spring automobile owners are preparing for the pleasures of the road this year as never before. As an indication of this tendency to prepare for a well-ordered season of tours as opposed to the hap-hazard methods that have obtained in the past, the fact may be cited that the Touring Club of America is now one of the busiest spots in metropolitan motordom. Every day requests of its members for interesting routings are being handled, and on some days the volume of these demands tests the force to the utmost.

Blue Book to Appear May 4

Section Number 3 of the Automobile Blue Book will be issued, according to announcement, on May 4. This volume deals with the best motoring routes in New Jersey and the South and contains a vast amount of valuable touring information. The other three sections of the work will be published shortly; two volumes making their appearance about May 11 and the last of the series following almost immediately. Each of the books contains a fund of interesting historical facts.

Fig. 10—Road to Mariel—100 miles from Havana

Connect the Cells in Series Using the Right Number

Editor THE AUTOMOBILE:

[2,631]—Please tell me how to connect up dry batteries, compound multiple series, for a longer life. H. O'NEILL.

Bayonne, N. J.

For economy of the battery it is necessary to take into account the characteristics of the coil, and if the energy transformation is made in the coil, after, say, 4 volts, it is important to use the number of cells in series that will deliver 4 volts; in other words, 4 cells; but if the coil is designed to operate economically on 6 volts, the thing to do is to employ 6 cells of dry battery in series.

If the individual cells of the dry battery are very small, their capacity may be increased by employing two series instead of one, in which event the connections will be in "parallel" series. If it is desired to increase the ability to a greater extent in this way, it will be in order to use three sets of batteries in series, with parallel series connections.

There is no economy in using a large number of small cells of battery if a smaller number of relatively large cells may be had. The illustrations, Figs. 1 and 3, show the various methods of connecting up the cells of batteries.

Having Trouble With a Sticking Disc Clutch

Editor THE AUTOMOBILE:

[2,632]—The multiple-disc in my automobile worked satisfactorily for several months after I purchased the car, but I am having trouble with it now, due to the fact that it sticks, thus causing an interference with the sliding of the gears. One of my neighbors said, "put oil in the clutch," which I did, but the result is worse than before, and I come to you for the remedy.

New York City. NONPLUSSED.

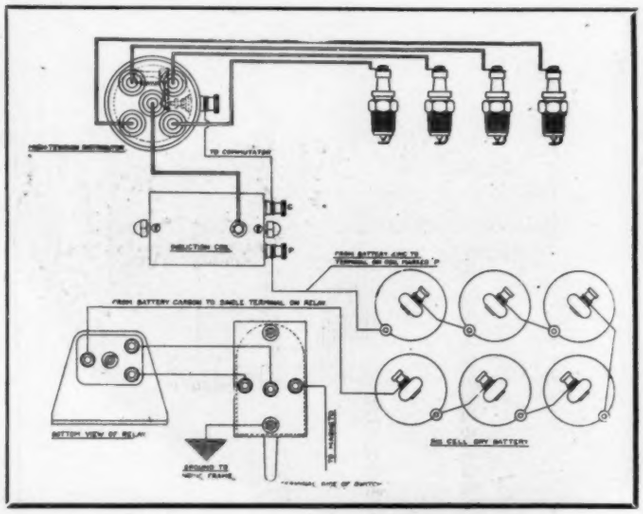


Fig. 1—Delco ignition system, showing the dry battery with the cells connected in series

What Some Subscribers Want to Know

The Editor invites owners and drivers of automobiles who are subscribers to THE AUTOMOBILE to communicate their automobile troubles, stating them briefly, on one side of the paper only, giving as clear a diagnosis as possible in each case, and a sketch, even though it may be rough, for the purpose of aiding the Editor to understand the nature of the difficulty. Each letter will be answered in these columns in the order of its receipt. The name and address of the subscriber must be given, as evidence of good faith.

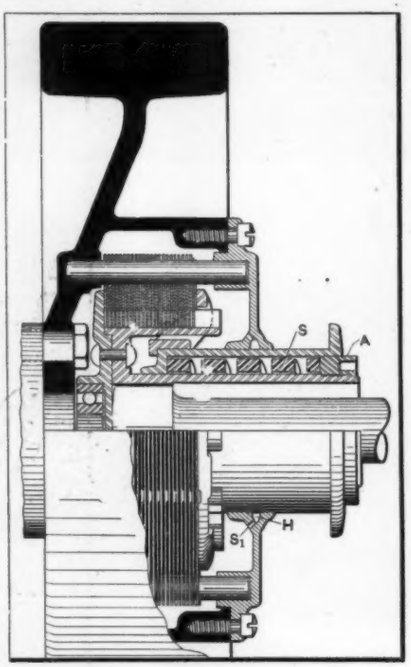


Fig. 2—Section of a Premier multiple-disc clutch, which may be operated either dry or when lubricated

Your clutch is gummed up, due to the fact that the oil that is put into the housing by the maker has never been replenished by you, and like everything else, it did good service until it wore out. What you have left in the clutch housing is the worn-out oil in the form of a gummy mass, floating a considerable quantity of solidified matter in the mother liquor, and some of these solids are caked on the surfaces of the discs, so that they prevent the discs from making metal-to-metal contact, but when you try to release the clutch, since the intervening spaces are filled with gum, freedom is lacking; moreover, the gum, instead of being a lubricant, may be regarded in the light of a poor quality of glue. Your remedy is a very simple one, but you will have to take the clutch apart and after scraping and cleaning the discs to remove all evidences of worn-out oil, it will remain to re-assemble the clutch and thereafter pay more attention to the lubricating problem or run the clutch dry. Fig. 2 shows a multiple disc clutch of the Premier type, and according to the maker, the service that it renders when not lubricated is very satisfactory indeed, so that running multiple-disc clutches without lubrication is not an uncommon thing to do. If lubrication is necessary in your case, the best lubricant to employ may be mixed by you out of light cylinder oil in the proportion of half and half with kerosene oil. Once a month the oil should be removed and after the housing is flushed out with kerosene oil put in a new supply of the lubricant as aboye named. When kerosene oil is mixed with cylinder oil it ceases to be a lubricant in the sense that it can be used safely in bearings, due to the fact that the presence of the kerosene in the oil causes the film to break readily, so that while a mixture of this type will serve very well to reduce the friction of the discs when the clutch is released, in the process of dropping in the clutch, the film of oil, instead of adhering persistently to the surfaces of the discs, breaks under the pressure and gets out of the way readily, which is one of the desired properties in clutch work. The kerosene oil also retards the caking or gumming condition which is so vexatious in your case.

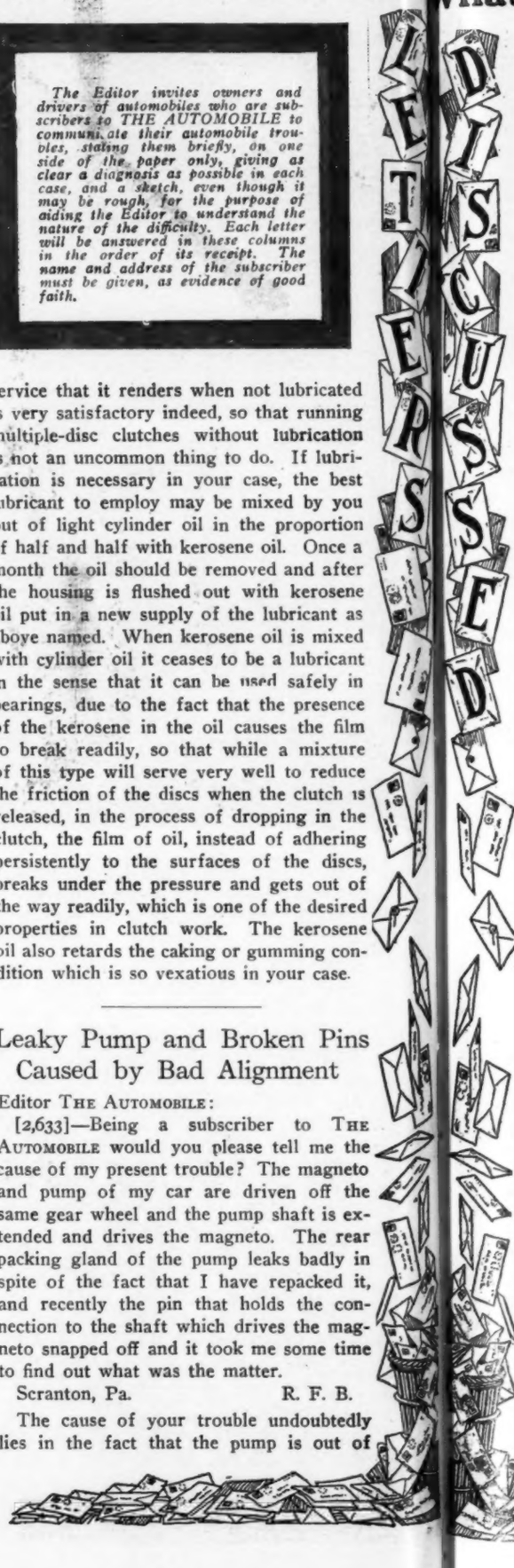
Leaky Pump and Broken Pins Caused by Bad Alignment

Editor THE AUTOMOBILE:

[2,633]—Being a subscriber to THE AUTOMOBILE would you please tell me the cause of my present trouble? The magneto and pump of my car are driven off the same gear wheel and the pump shaft is extended and drives the magneto. The rear packing gland of the pump leaks badly in spite of the fact that I have repacked it, and recently the pin that holds the connection to the shaft which drives the magneto snapped off and it took me some time to find out what was the matter.

Scranton, Pa. R. F. B.

The cause of your trouble undoubtedly lies in the fact that the pump is out of



What Other Subscribers Have to Say

The Editor invites owners and drivers of automobiles who are subscribers to THE AUTOMOBILE to communicate their personal experiences for publication in these columns for the worthy purpose of aiding brother automobilists who may be in need of just the information that this process will afford. Communications should be brief, on one side of the paper only, and clearly put, including a rough sketch when it is possible to do so, and the name and address of the writer should be given as evidence of good faith.

alignment either with the motor shafting or the magneto or both. Let the motor run and hold a piece of chalk against the coupling, and if it does not make a mark all the way round you can find out which way it requires to be moved to bring it back into line. All that will probably be necessary is to enlarge the holes through which the holding-down bolts pass. You can overcome the shearing trouble by having Woodruff keys fitted to the couplings as well as the cross pinning and this will be seen in Fig. 4.

Both Types of Clutches Have a Good Record

Editor THE AUTOMOBILE:

[2,634]—Will you kindly answer the following question in THE AUTOMOBILE: What is the difference in construction between the multiple-disc and cone clutch, and which is considered the most durable?

Whitewater, Wis. SUBSCRIBER.

The cone clutch comprises two members, one of which is formed out of the rim of the flywheel, which is tapered off to an angle slightly under 10 degrees, and the mating member is composed of a truncated cone with a leather facing attached to a hub through a spider. This member is pressed against the engaging faces of the flywheel by means of a spring, when the clutch is in the position designated as "engaged," and to disengage the clutch pressure is applied to a pedal through which the spring pressure is relieved.

A multiple-disc clutch comprises a series of flat steel or other metallic plates, one-half of which are keyed or splined to the housing which is attached to the flywheel of the motor, and the other half of which are keyed or splined to the Cardan shaft. To engage the clutch the discs that are keyed or splined to the Cardan shaft are pressed against the discs that are keyed or splined to the housing that is in rigid relation to the flywheel. Driving takes place, due to the friction that obtains between the two sets of discs. When a small number of discs as 5, 7, 9, or 11 are used they are faced with asbestos fabric in order to increase the friction of contact sufficiently to afford the requisite twisting moment, but when the number of discs are increased to upward of 50 they may be run in oil, although in some examples of this character the discs are run in the dry state.

Magneto Ignition Too Retarded

Editor THE AUTOMOBILE:

[2,635]—I have been having trouble with my automobile, and being a subscriber to your journal, would be pleased to have you help me out. The trouble seems to be in the ignition system which consists of magneto and dry battery. When running on battery it runs real good; it has a transformer coil which has to carry the current through the magneto from dry cells. It runs well on the battery, but as soon as the switch is turned on the magneto it will begin to pop and only about half of the explosions occur. I have examined the timer and it seems to be in good condition, and also the five carbon brushes on the magneto, and it all seemed to be in good condition, and the spark was good enough from magneto to start the engine. I have taken out the plugs and the spark seems to be all right. It seems also when running that the water gets boiling, which it has never done before. This engine has not given me any trouble until this has occurred. It seems to me it must be in the magneto. I have tried every suggestion I know of but to no avail, and would be pleased to have you help me out.

E. S.

Rossville, Ind.

There is every indication of the fact that the magneto ignition spark takes place too late. In a magneto, if it has been working satisfactorily, and the indication of a retarded ignition creeps in, it is a sign that the magnets are losing their ability, and the way to overcome this difficulty is to advance the spark to the limit, and then change the meshing of the magneto gear one tooth in its mate, if necessary.

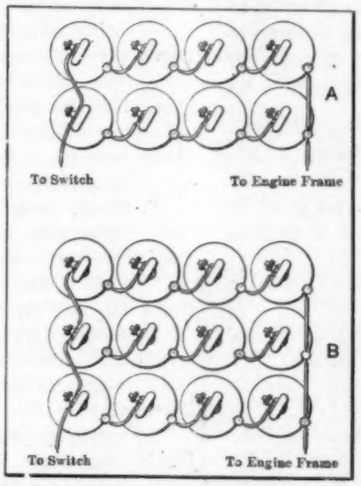


Fig. 3—(A) Battery in parallel series, showing two rows of four cells each, and (B) battery of three rows of four cells each in parallel series

Experienced Automobilist Gives Some Timely Information About Reliners

Editor THE AUTOMOBILE:

[2,636]—Having had some experience with reliners or inner tube casings, would say to E. C. B., No. 2,541: If your casings are in good condition, do not put anything in them, as reliners tend to make tires heat up and lose in buoyancy, but if the casings are getting weak or badly worn reliners will add to their mileage and prevent blow-outs. Do not use a reliner that is cemented to stick to the inside of the casing, or it will loosen the inside pieces of the fabric and damage the casing. I think for old or worn casings reliners will prove a good investment.

Cherry Creek, N. Y. REPAIRMAN.

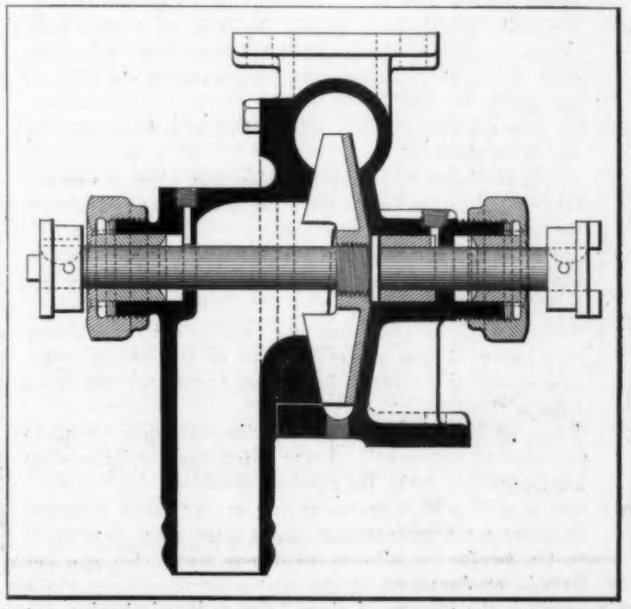


Fig. 4—Showing the packing glands of a water pump and keyed connections

When Judgment Whispers Don't

Epigrammatic Presentation of Things to Remember

Don't fall on the neck of the salesman when he tells you all the sweet confusion of the innumerable melodies that reside in his make of automobile—what do you want with a melodion?

Don't smell of new-mown hay when you negotiate for the purchase of a pair of second-hand headlights—your ways will be more illuminating than the lamps in that event.

Don't dwell on the advantages of an automobile what gives off a hundred floating odors—the trouble may not lie solely in the carbureter.

Don't upset principles—in a paragraph there must be a subject and a predicate; the subject is what the paragrapher writes about and the predicate expresses sentiments. Likewise in buying the automobile is the subject, and what the purchaser has to say about it later on is the predicate.

Don't violate the law of probability—if the maker is above reproach, the laws says, "the maker's product will be on a high plane."

Don't see with a blind-man's eyes—skill may produce a good set of brakes, but it is skill also that substitutes a fetching salesman's argument.

Don't mix up character with reputation. Character is what a man is; reputation is what he is thought to be.

Don't forget that the vulture has talons—take along a chiropodist's set when you set out to entertain the vulture.

Don't make comparisons without looking for contrast. That is how a cormorant espies a fish in an estuary.

Don't under-estimate the influence of the Gulf Stream on commerce—it secretes hulks also, but not all of them—keep a good outlook.

Don't inhale a poisonous subtile fluid. The vapor may be deadly in its infectiousness. The breath of the chauffeur for instance.

Don't be blind. If you are a chauffeur and you drive for a family of good taste, you do not have to contribute a good smell—take a butt.

Don't stigmatize quality as it adorns the crest of a good automobile by driving the machine to destruction—take your time, it is more numerous than the water in the belly of the ocean.

Don't toy with the fangs of a condemned idea; take a hack-saw and level them.

Don't sully a mechanic by imitating a plowman when you undertake to adjust the carbureter on your motor—approach the subject with some deliberation.

Don't undertake to enumerate the persons who run automobiles, but who do not try to master their intricacies—they are legion.

Don't skylark with the idea that was expressed by the fellow who said: "I like 'chatty' stuff in an automobile magazine—what do I want to know how to run one for, haint I got a chauffeur?

Don't dream of Valrosa and perpetual Summer while trying to purchase an automobile. Sharp wit, a keen vision ond an alert condition make for painless dentistry.

Don't take a skiff with a teaspoon for an oar down Niagara. It is the same performance to go after a car, leaving it to the vendor to tell you what you want. Do you believe in soothsayers?

Don't overlook the efficacy of sleep. Get a fill of slumber the night before the purchase; go after the car with the intellect fully awake.

Don't forget that sleep is the kinsman of death—the death of your pleasure if you buy a car while you are in slumber deep.

Don't look for notoriety through purchasing a poor automobile—elope with a colored lady—the result will be the more swift but not less certain.

Don't say "It is sharper than a serpent's tooth to have a thankless child," and then invent a mechanical wheel—the child will be as indefatigable as twins then.

Don't rave about deathless virtue and perpetrate the immortal crime of putting a 12-inch searchlight on a runabout.

Don't mix imprudence with generosity; your imprudence and the second-hand man's generosity.

Don't look for the antithesis of undue haste in the purchase of an automobile—it is misery.

Don't miss the point: a juggler may be able to catch four balls at a time—will you contribute one of them?

Don't fill the second-hand man's vat while you lead junker to the boneyard.

Don't let your misfortune serve as the stepping stone for the fellow who unloads a decrepit automobile.

Don't fall into the abyss of the feeble-minded—have your automobile overhauled.

Don't bow down before the salesman whose effort is a tame argument boiled to rags—furnish the logic; depart.

Don't allow poverty to freeze a genial spirit—keep your money until you can get value for it.

Don't, like Rome, squat on seven hills, and from your seat of beauty try to rule the chauffeur—pinch his tail.

Fire in the Garage

A large, square sheet-iron pan filled with sawdust, and so placed under the car that it will catch all the drippings of gasoline and lubricating oil, will absorb the dangerous fluids and prevent their evaporation.

A FRENCH authority, in discussing repair pits in garages, says the soil and sides of the pit finally become so saturated with inflammable products that they are much more to be feared as a cause of fire for the reason that they are seldom considered in that respect. It is therefore necessary to take certain precautions. A judicious but somewhat costly method consists in establishing a series of air vents in the walls along the level of the floor; there will then be no stagnation of inflammable fumes. Such a solution, however, makes it uncomfortable for the feet of the mechanic in winter time, when he does the daily chores of the machine. The aforementioned authority thinks that the most practical means for avoiding the danger consists in leaving permanently under the vehicle one of those large sheet-iron boxes which are used under automobiles exhibited in salesrooms to avoid soiling the floor with oil drippings. A box of this kind should be filled with sawdust and this should be renewed every day. Sawdust absorbs a very considerable volume of gasoline and thereby prevents its evaporation. It offers, moreover, another advantage, as it makes an excellent soap for the mechanic and one which costs next to nothing and does not ruin the hands. Mixed with brown soap it removes grease from the hands, without affecting the skin, better than any other substance.

Short Stories of General Interest

Intended to Explain the Puzzling Situations

The automobile as an instrument of transportation, discussing its economic phases, taking into account the stroke of the motor and relating matter, also touching upon the tire problem. An attempt is being made through a studied presentation on a basis of brevity to lift the haze that obscures the vision of the man whose time does not permit him to ramify.

LONG-STROKE motors deliver power on an increasing basis, relatively speaking, if the mean effective pressure persists. The horsepower expectation from any motor is on a basis as follows:

Let

P = mean effective pressure;
L = length of stroke in feet;
A = area of piston in square inches;
N = number of power strokes per minute;

When

$$\text{H. P.} = \frac{\text{PLAN}}{33{,}000}.$$

Since the length of the stroke is constant in a given motor and the area of the piston is an unchanging quantity, the only values that can be varied are the mean effective pressure and the speed. If the mean effective pressure persists, the speed will grow, or the power will be augmented at a given speed. As a general proposition, allowing that the mean effective pressure will remain stable as long as the speed is not increased beyond a certain point for a given motor, the power will increase in direct proportion to an increase of stroke.

WHAT possible use it is to talk about the cost of tire maintenance and run an automobile on partially deflated tires it is extremely difficult to say. How much pressure to maintain in the tires is a debatable question. If the automobilist is afraid that the fabric of the tire will be damaged by pressure let him take comfort from the information that even a small bicycle tube will work without being damaged by pressure up to 500 pounds per square inch. How much pressure it would take to disrupt a 34 x 4-inch casing is difficult to say; surely more than the amount that can be put in the tube by any form of hand pump and all that the average power pump is capable of delivering. It is not desirable to pump the tires up so hard that the machinery of the automobile will be vibrated excessively, and this is the condition that must be thwarted, rather than to fear that the casings will be damaged by the pressure.

There is something to be said for pure air as the medium to use in the inflation of tires. There may be other mediums that will do very well. If the makers of tires will state the limitations from this point of view it will be something for their patrons to pay attention to; it being true, no doubt, that makers of tires are good judges of the practice that may be looked upon as safe.

HOW to store tires so that they will keep for a long time without deteriorating is a problem that the average automobilist seems to pay but little attention to. Investing in extra tubes and casings should be regarded as a serious matter from the economy point of view, unless it is possible to so store the tires that they will preserve their original qualities. Rubber is a delicate substance in quite a number of respects. It is also a very hardy material, as its use in tire service proves. What is the reason why rubber proves so disappointing to some automobilists and works so well for others? Is it not a secret that is coupled with the storage problem?

The Editor of THE AUTOMOBILE, desiring to learn something about this matter, placed a tire in the cellar of his residence and kept it there for three years, after which it was taken out and placed in service with excellent results; the tire stood up alongside of a new equipment. A second tire was placed in a warm room near the top of the house, where the light was strong as well. The tire fell apart after about six months; it was in such bad shape at the end of that period of time that it was useless to try to get service out of it. What is the conclusion to reach?

MUST we learn to our cost? Is there no other way to get the benefit of experience? Take for illustration the life of a good automobile; does it last too long? Would it not last much longer were it operated at a lower speed? If so, and it seems to be a reasonable proposition, why do automobilists persist in running their cars so fast that laws have to be framed to protect the public, and, let it be said, the speed-mad from themselves? It has been said that the life of an automobile will be four times as long under a given set of conditions if the speed is reduced by one-half; is this not worth considering? The poorly directed automobile as it goes tearing along the highway averages about 20 miles per hour during a day's run, and a well-driven automobile, for an equal length of time, will average 18 miles per hour. The well-driven automobile will arrive at its destination a few minutes after the other car, and, considering the fact that there will be few, if any, pauses on the road to fix tires, it is possible that the well-driven car will be the first to put up at the end of the day's run. The well-driven car will last four times as long as the car that is punished.

GRANTING that a motor, if it is to render excellent service, must be properly nourished, it remains to state that a good fuel system is the remaining requisite. In a capable fuel system, to reckon with the carbureter is the proper course. The carbureter can be of a good make and fail utterly to satisfy the owner of the automobile. Why is this so? The carbureter may be too small for the motor. If the motor in a given automobile is big enough to take the load up a given grade on high gear and fails to do so, to look at the carbureter for the trouble is the wise course. How will the automobilist go about it in looking for trouble? Will he wait until the car reaches the top of the hill and then adjust it? Yes. What good will it do him to thus undertake this important task? None. Why? Due to the fact that the basis of the trouble is to be found on the hill rather than at the top of the same! If the carbureter is lacking in capacity the motor will run out of breath on a long hill although it may not be very steep, and the same motor with its carbureter may take the car up a relatively steep hill if it is not very long. Look for the trouble in the carbureter under the very conditions that it creeps in.

IF tires are over-inflated, mechanisms will be shocked to uselessness.

Tools for the Private Garage

Informing the Owner What to Do for His Success

Assuming that a chauffeur is to care for and drive the automobile, the private garage owner is advised to supply facilities for prompt and efficacious repairing undertakings. A good man without facilities is like a ship without a rudder. As one of the first requisites in the private garage is a small power plant to drive the tools necessary for efficient work, an electric motor of from 3 to 5 horsepower should be installed. The floor plan of a garage that should answer all the requirements is also presented as a guide to the owner.

THE private garage should be large enough to accommodate the tools that must be at the disposal of the man who may be engaged to do all the work, including the driving of the automobile.

If tools are to be provided the first requisite is in the form of a power plant whereby the driving of the tools will be accomplished. An electric motor would serve well the intended purpose. The rating of the motor should be from 3 to 5 horsepower. It must be wound for the voltage of the circuit from which the electricity is to be tapped. The speed of the motor should be maximum at 1,000 revolutions per minute, and it should be installed outside of the garage proper on account of the fire hazard, in view of the fact that the spark that is induced at the commutator of the motor would be hot enough to ignite mixture such as might be due to a leak at the gasoline tank or a drip from the carbureter.

By placing the motor adjacent to the part of the building in which the automobile stands and belting the motor to a shaft that extends through the wall near the ceiling it is possible to avoid all danger of igniting mixture.

As an illustration of a garage, referring to the floor plan, of the character that holds a good measure of safety, Fig. 1 is presented. In this example the garage is 19 feet 10 inches by 25 feet, with a wide double door at the front and back. The workshop is of the same dimensions, adjoining, with a fire wall between, and the power plant, as well as the heater, is placed in a fireproof extension to the left in the manner as shown.

Garage Floor of Cement Should Be Free From Pockets and Depressions

The advocates of a "pit" in a garage do not seem to appreciate the fact that gasoline and air combined form a mixture that is heavier than air, and this explosive will settle down into convenient pockets, of which a pit is a good example, ready to be inflamed by a naked flame, as from a match or otherwise. Let the floor be without pockets and for safety place ventilators so that air from the level of the floor will be wafted away to join the passing breeze. Of the architecture, there is nothing to be said: the treatment of a garage must accord with the style and scope of the architecture of the residence nearby.

The water that is used in washing the car must be gotten rid of, and the sewer is the place to lead it to, but the connection at the low level of the cement floor of the garage should be provided wth a syphon form of trap. There should be no escape for mixture to the sewer.

What Tool Equipment to Select for a Small Unpretentious Private Garage

Down by the seashore, and for 50 miles back therefrom, tools are rusted by the salt sea air. Deterioration is difficult to thwart and the tools that survive the wiles of salt are in more or less constant use. The grease and oil that smear over the tools save them from the rust.

From the first-cost point of view a very few well-selected tools represent the superior choice. From the rust standpoint the less there are of the tools the more will they be used and the less marked the deterioration. Select tools of broad utility. Combination tools, in fine, universal tools, so called. Let the man exert himself a little : rust will hie away from him too, then.

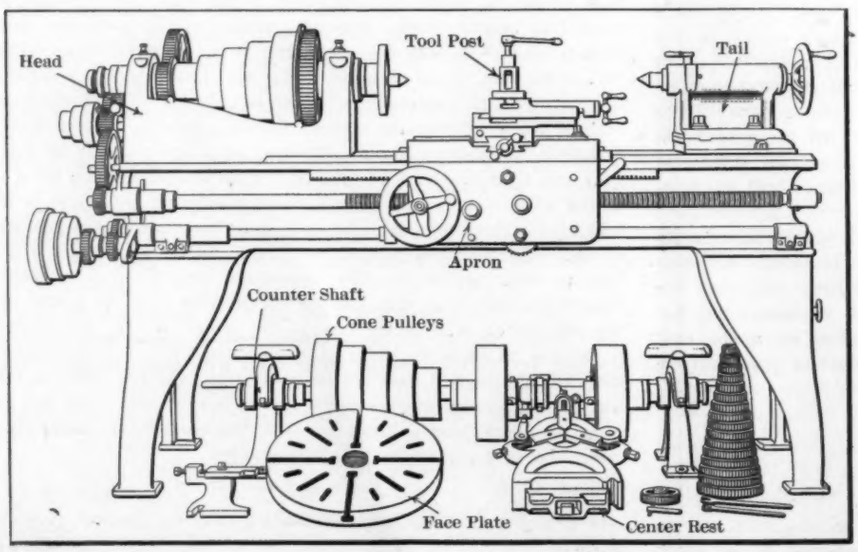


Fig. 2—18, 20 and 22-inch swing engine lathes for use in garage service

Small Tools for Bench Work Should Be Kept in a Bath of Soda Water, a Little Paraffine Oil Floating on the Top

Almost no amount of wiping, oiling and painstaking care will save tools from rust, especially near the salt of the sea. But if the small tolls are kept submerged in pails of soda water, two things will transpire, *i. e.*, the tools will be kept clean and they will resist rusting influences.

On a shelf, rather low down, place a row of wooden pails, mark with a stencil (on each pail); drills, wrenches, cold chisels, screw-drivers, bitts, punches, etc. If oil baths are preferred for the storage of tools, let the owner cater to his own inclination.

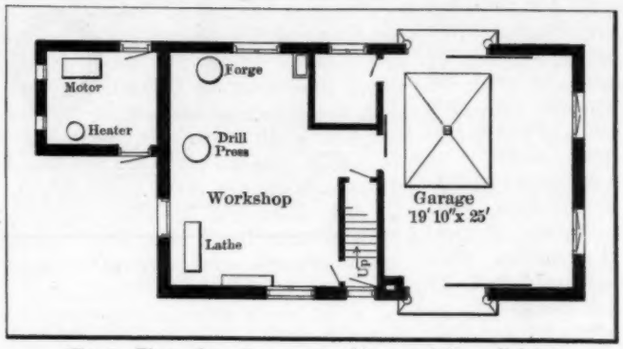


Fig. 1—Floor plan of a garage with a workshop adjoining

Machine Tools Suitable for a Small Garage

If a lathe is to be of excellent value in a private garage it must be large enough to swing a cylinder of the motor when it is desired to lap the same, or provision must be made to do this work in a vertical drill press.

In view of the excellence of the work that can be done in a lathe and the wide range thereof, preference should be extended to this type of tool, and in selecting a lathe, to be guided by the specific situations, is in the path of fine practice.

The lathe, beyond being large enough to swing the motor cylinders and with a distance between centers to accommodate the crankshaft, should be limited in size so that sensitiveness may not be sacrificed. But if the motor is of the *bloc* type with four cylinders cast integral, the plan of using a drill press must be given preference in any event.

If the situation calls for a relatively large drill press, get a small lathe, but if the lathe is large, get a smaller drill press.

Engine Lathe Should Be Simple and Modern

Quick-change gear patterns are not necessary; they would scarcely deliver a return upon the extra cost involved.

Fig. 2 shows a type of engine lathe made in 18-inch, 20-inch and 22-inch swing sizes, that serves well for purposes of illustration here. In this lathe the main features are as follows:

SPECIFICATIONS OF THREE SIZES OF ENGINE LATHES

	18"	20"	22"
Swings over ways	18¼"	20½"	22½"
Swings over compound rest	12¾"	13¾"	14"
Distance between centers, 8' bed	46½"	42"	37"
Diameter of front bearing	2 13-16"	3"	3½"
Length of front bearing	6"	6½"	7"
Diameter of rear bearing	2⅜"	2½"	2¾"
Length of rear bearing	3⅝"	4"	4⅜"
Diameter of spindle nose	2¾"	2¼"	3⅛"
Diameter of hole in spindle	1¼"	1¼"	1½"
Change gears cut from	2 to 36	2 to 18	1 to 18
Width of cone belt	2⅞"	3¼"	3¼"
Largest diameter of cone	12¼"	13½"	15"
Diameter of counter pulley	12"	14"	14"
Face of counter pulleys	3⅝"	4⅜"	4⅜"
Speed of countershaft, R. P. M.	220	220	220
Weight, 8' bed	2,250 lbs.	2,920 lbs.	3,880 lbs.

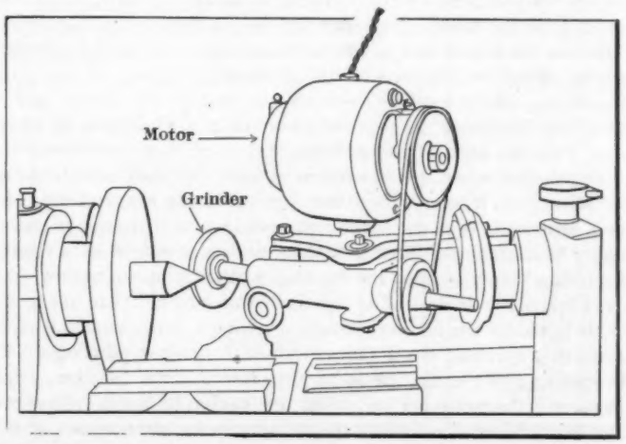


Fig. 4—Motor-driven grinding attachment for a lathe, to be used for dressing tools, grinding centers and taper

The features of this engine lathe that do not appear in the specifications are catalogued as follows:

The head stock is very rigid. The metal is properly distributed to resist all strains that must be sustained by it. It has a five-step cone, large diameter, and with extra wide face.

The spindle is of high-carbon steel, ground to size. Bearings are of hard bronze, very large, with proper oiling facilities, and have means for adjustment when necessary.

End thrust of spindle is sustained by a step, firmly bolted to end of head stock, entirely independent of the spindle.

The tail stock is the original of the offset type, allowing the compound blocks to be set in a plane parallel with the bed. Provision is made so that the tail stock can be set off center for turning taper. As a whole, the tail stock is in keeping with the excellent general character of the machine.

The carriage, which is heavy, has a very stiff bridge, long bearings on V's, and is securely gibbed to the bed. The compound or plain blocks are very wide and generously proportioned.

The apron is bolted firmly to the carriage. All gears in apron are amply strong to carry their load. When screw cutting, the rack pinion can be withdrawn from the rack, preventing rotation of gears and hand wheel while carriage travels back and forth on bed.

Feed works. On the standard pattern lathe three changes of belt feed can be had by means of the three-step cone. Three other changes are made by changing gears, making in all nine changes of feed.

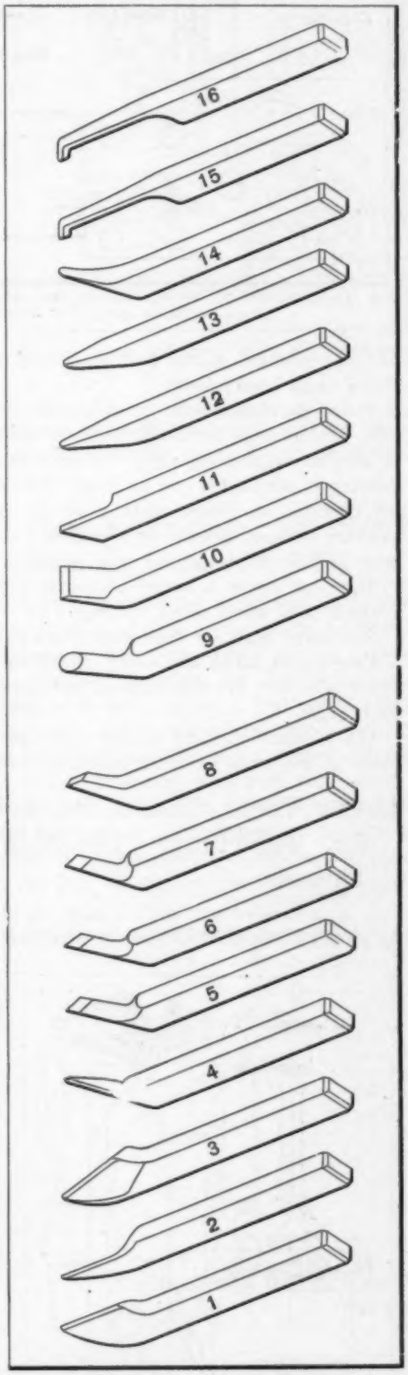


Fig. 3—Hand-forged lathe tools, making a complete assortment

The belt tightener keeps the feed belt always taut.

Positive geared feed is supplied with each lathe. To use the same it is only necessary to swing the belt tightener up, so that the gear on the hub of feed cone meshes with gear which runs loose on splined bushing which is on lead screw; the number

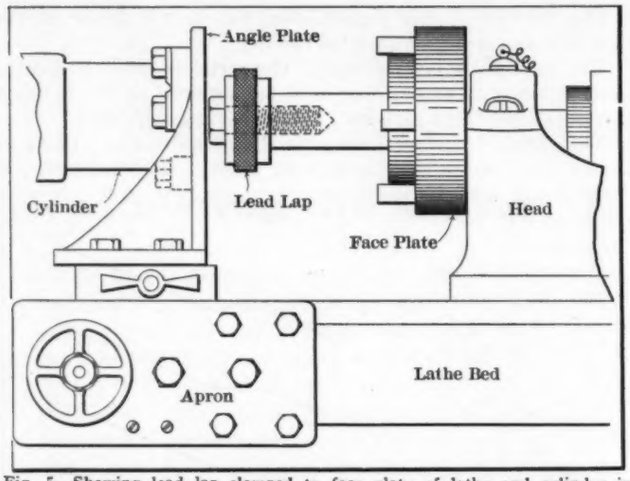


Fig. 5—Showing lead lap clamped to face plate of lathe and cylinder in place ready for lapping

of feed changes to be had is limited only to the number of change gears with lathe.

When furnished with quick-change gear, the mechanism permits of a change from one feed to another or from one thread to another, almost instantly. A wide range for screw-cutting or feeding is obtainable and an index plate on the head stock makes all changes so simple that even an inexperienced hand can operate without trouble or mistakes. On the quick-change gear type of lathe there are no loose gears.

The lead screw is large, of coarse pitch and accurate, and is rotated only when screw cutting.

Automatic stop for feed disengages clutch on feed rod.

Face plates, large and small, center and follower rest, countershaft with two friction pulleys, and wrenches are supplied with each lathe.

When specified with order, taper and electric motor attachment of any style or make motor are supplied at extra cost.

Lathe Tools Should Be Selected with Care for Roughing, Finishing and Chasing Threads

If it is desired to "hog" a piece of alloy steel, the tool must be properly designed of suitable steel, carrying about 20 per cent. of tungsten, but tools of this character are of no value when threads are to be chased or if finishing cuts are to be made. A fine grade of carbon tool steel will best do the intended work in the latter cases.

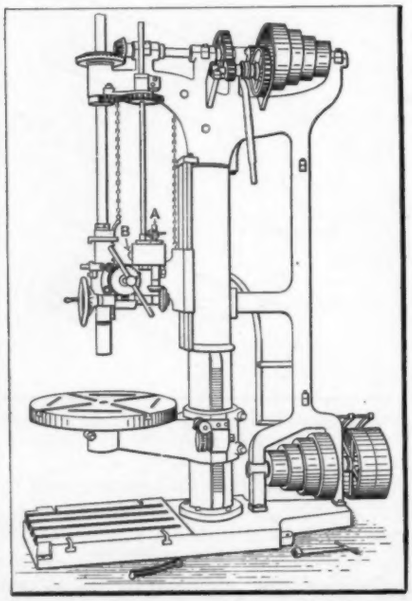


Fig. 7—24-inch drill press for use with independent compound table or as illustrated

Fig. 3 shows the set tools that will do any kind of a job on a lathe.

The tools illustrated in Fig. 3 are technically known as follows:

1. Left side tool; 2. right side tool; 3. left side tool, bent; 4. right side tool, bent; 5. heavy diamond point for cast iron; 6. diamond point for steel and wrought iron, right hand; 7. diamond point for steel and wrought iron, left hand; 8. half diamond point; 9. round nose; 10. water finishing tool; 11. cutting off tool; 12. roughing tool; 13. thread tool; 14. bent thread tool; 15. inside turning tool; 16. inside thread tool. If tools are necessary, so are the facilities for their proper grinding, and one of the requisites is some means to keep the sharp point or edge "dressed."

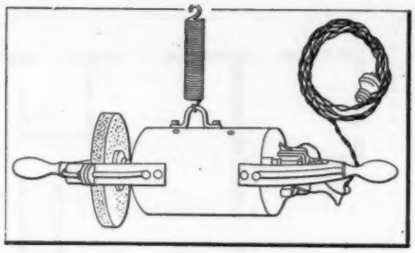


Fig. 10—Portable electric buffer and grinder for garage service

Dull Tools, Like a Dull Wit, Conspire Against Success

Of the equipment that is available, the motor-driven center grinder shown in Fig. 4 is by way of an innovation that can be dispensed with, but it offers excellent advantages, among which mention will be made of the fact that the lathe centers may be dressed and taper fits may be made and ground to exactness. This tool is not so high-priced as to bar it from the owner's shop.

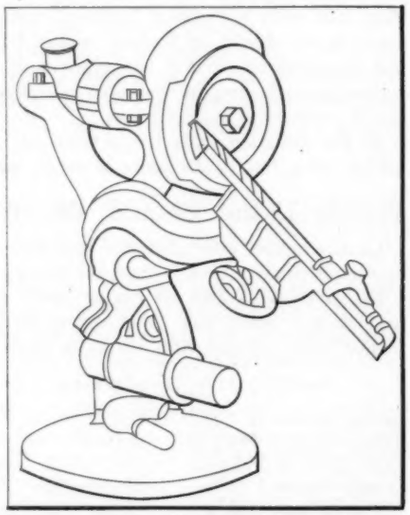


Fig. 9—Bench type of grinder for drill sharpening and similar undertakings

The proper equipment of a lathe for repair work includes: one 3-jaw universal chuck, one 4-jaw universal chuck, one medium diameter face plate, one large diameter face plate, one cylinder finishing lead lap, one drill-clamping fixture, one angle plate designed for securing to cross rest (Fig. 5).

In the case of the lead lap, as shown in Fig. 5, the "plug-hat" casting that is chucked or fastened to the face plate as the case may be, the cylinder must be bolted to an angle plate as also shown, and the center of the bore of the cylinder must be on the axis of the spindle of the lathe. The lead lap, in the form of a disc about 2 inches thick and in diameter equal to the bore of the cylinder to be lapped, is centered on the reduced extension of the plug hat fitting and is clamped between the end of the fixture and a cast-iron disc about 3-4 inch thick and about 1-2 inch less in diameter than the bore of the cylinder.

In practice, when it is desired to refinish a cylinder, the lead lap is "sized," the clamp is tightened up, squeezing the lead disc out to a little more than the bore of the cylinder; a sizing cut is taken, using a diamond-pointed finishing tool and allowing a slight "entering" taper so that the lead lap will start in the bore of the cylinder. If it is desired to lap out 0.010 inch, all that has to be done is to size the lap accordingly or make a 3 or 4-pass job of it, squeezing the lead out a thousandth or two after each pass. In the passing of the lap, the lathe is started and the cylinder is fed in toward the revolving lap, doing the feeding by hand. After the lap enters it remains to feed the cylinder in for the distance of the bore and by feeding in and out, if the lap is coated with "Eureka"

grinding material (powdered glass with a binder to form a paste) the bore of the cylinder will be lapped out to the diameter of the lead lap and it will assume a round, true and polished surface.

A big drill-press for the money, or, in view of the moderate first cost of this class of tools, is a grave temptation, but sensitiveness disappears as the size is increased. Get a drill press big enough for the work, but stop at that.

If there is to be any extravagance at all, to have an independent compound table, as depicted in Fig. 6, would be a stroke of genius. This table would make a plain drill-press into a "universal" of scope.

For a 24-inch plain drill-press, as shown in Fig. 7, the independent compound table would be 18 by 24 inches, with a cross feed of 14 1-2 inches and a lateral feed of 15 1-4 inches. The height to top of platen is 20 inches.

The drill-press as shown would be superior to a press combining a table on account of the 24-inch vertical feed of the 21-inch (diameter) table, for many cases, although the drill-press as shown in Fig. 8, with compound table, is a very attractive tool.

Sharpening Tools Is Something of a Task for an Expert—How About a Novice?

Half of the battle in repairing work is to have sharp tools. An amateur, full of ambition, labors under the disadvantage that he works with dull tools. The reason for this lies in the fact that to sharpen tools takes skill and even the expert in the tool room of a plant has to pay a little attention in order to obtain the best result. For the amateur it will be best to include in his equipment some form of grinder, fitted with tool-holders, such as will aid him to properly "edge" his drills, lathe tools and such other tools as he will be likely to employ in his work.

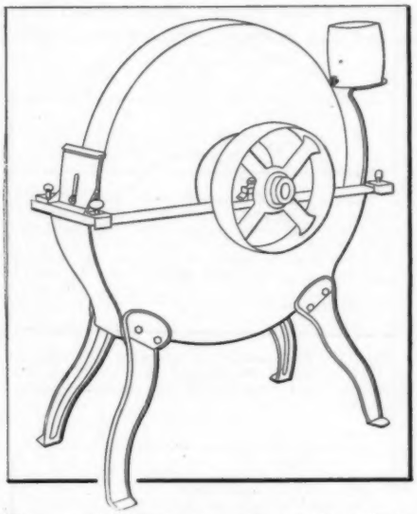


Fig. 11—Grindstone for use in the private garage

Fig. 9 represents a bench drill grinder of low first cost that will be of considerable utility in this service. It is the part of wisdom to grind a dull-edge tool as soon as possible rather than wait until it is needed.

For buffing and even grinding work of a certain class the electrically driven buffing and grinding equipment shown in Fig. 10 is a most desirable garage tool. With the flexible shaft it is possible to go around the car and clean up the brass work with but slight effort, while the quality of the polish imparted will be unexcelled.

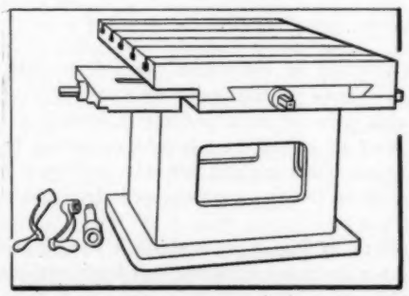


Fig. 6—Independent compound table for use with a plain drill press

To do without a grindstone is not to be thought of and to get a good one is wise. Fig. 11 shows a 24-inch grindstone of a thickness of 3 inches, mounted in an iron trough with shield water bucket and pulley ready for the belt.

The "forge" should not be too small. It is a great mistake to get a small "scientific" portable, so called. Select a blacksmith's forge of a size that will serve well for quite heavy work. Fig. 12 is designed to do the intended work.

What a tragedy it would be to fit out a small garage and to neglect to provide an anvil and tongs, adding a modest smith's equipment, including a few fire bricks and a brazing equipment, if funds are available, although brazing, as a general proposition, is not so desirable as to be recommended for a steady diet.

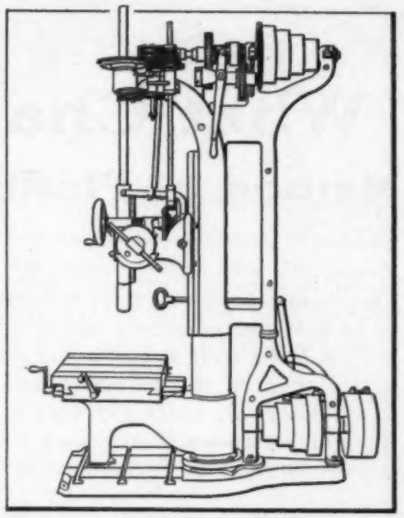


Fig. 8—24-inch drill press fitted with compound table

A Good Small Tool Equipment for Bench Work Represents an Outlay of $100

It is not the purpose here to outline the small tool equipment for a modest garage repair shop. Large sums can be expended in this way; $100 will cover the necessities. Get a limited number of good tools; include files that are standard; price is a secondary consideration in such matters. Perhaps a chain hoist will be worth including. And now that the story is ended, it will be observed that a milling machine and a shaper are not included. The former, if it is a worthy tool, runs into money; if it is not a good one, why have it? The latter is to be done without. Use the forge instead; get accustomed to fashioning parts from convenient shapes of bar stock that can be had from the iron monger; put the iron in the fire and shape it under the hammer.

From this point on it is a simple undertaking to so fashion the parts that they will go into place, using the machine tools available, supplemented by bench tools, remembering that good files are of the greatest utility in the process. In the ordinary course, when an automobilist goes into a hardware store to procure files, he is easily satisfied with what is handed to him over the counter by the salesman, whereas in shop practice, care is taken in the selection of these little milling machines, for such they are.

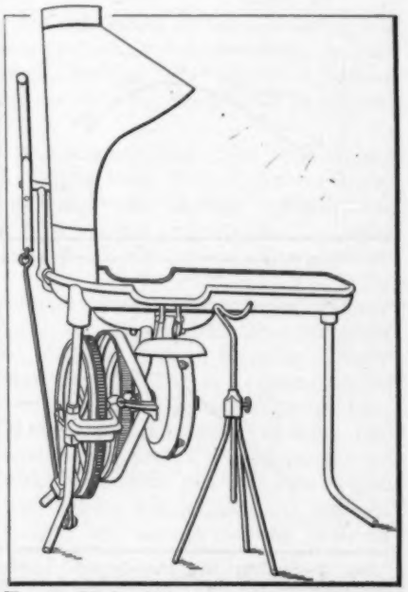


Fig. 12—Blacksmith's forge of a size for use in a small garage

What Characteristic Curves Show

Method of Plotting Curves and How to Draw Conclusions from Them

The characteristic curves of internal combustion motors can be plotted with the aid of any machine that gives the brake tests at varying speeds, and it is proposed to show in the following article from the pen of Henri Petit, which appeared in La Vie Automobile, how faults can be remedied which are made apparent through the fluctuations in the curve.

BY the simple inspection of the lines of the hand, palmists are able to discover past events in the life of the client, and seem to be able to predict the future. It is proposed in this article to exercise a similar divination as to what takes place in an internal combustion motor.

This task will be much simpler than that which falls to the lot of occult scientists, and with a little less imagination the results that will be obtained will have the assurance that they will possess a greater degree of probability if not certainty.

Every one can read the "hand" of a motor; supernatural gifts are not necessary; all that is required is a little reflection.

The mystic lines from which the conclusions are to be drawn are two in number, viz., the diagrams of the cyles and the curve called the *characteristic* of the motor. It is proposed to review the latter first. Presuming that the reader has some idea what the characteristic of a motor is, it will only be necessary to give a brief description of same to define it.

Take two lines, drawn at right angle o x and o y, as shown in Fig. 1. After starting the motor it is put on a brake test in order to find the power given off during the whole time that it is running. It is of no moment what type of brake is used, whether it be the old Prony brake, the Renard moulinet or the conventional dynamo. No matter what the type of instrument, it will give the power of the motor at every period. The tachometer will give the angular speed which it is possible to measure off in revolutions per minute.

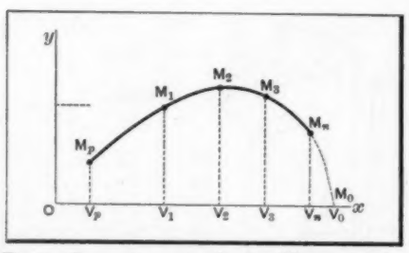


Fig. 1—Curve of a motor for its different angular speeds.

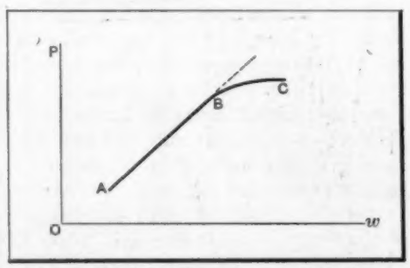


Fig. 2—Straight line characteristic between the points A and B. The coupled motor remains perfectly constant up to a certain limit of speed, which shows that the motor is being well nourished.

With the motor running at a given speed V_1 the corresponding power will have a value that can be determined, P_1. Mark off on the line o x a length o V_1 proportionate to the speed V_1. From the point V_1 draw a perpendicular line which will give the length V_1 M_1 proportional to the power. By this means we obtain a certain point M_1. With a variation of speed the power will vary also. If the same method is followed for all speeds V_1, V_2, V_3 and V_n it will be possible to obtain a series of points M_1, M_2, M_3 and M_n.

The characteristic of the motor is obtained by joining all the points M by a continuous line.

Examination of the Characteristic Will Not Permit Us to Foretell the Future of the Motor, but at Least Will Form a Basis for Determining Some of Its Qualities as They Are Presented

The average characteristic of a motor is shown in the form presented in Fig. 1. It starts at a point M_p, which corresponds to the lowest speed at which the motor will run with regularity. With an increase of speed of the motor the power increases as well, which is shown by the rising curve. This takes a form of a straight line at first and then develop a decided curve, which increases.

The maximum power is obtained at a certain speed, and for the moment let this speed be known as the critical speed. If the speed is increased still further the curve falls off slowly at first and quickly afterwards. A time will arrive if the speed is increased when the motor will only have sufficient power to overcome the passive resistances; the available power will be zero and the curve will intersect the line o x at the point M_o.

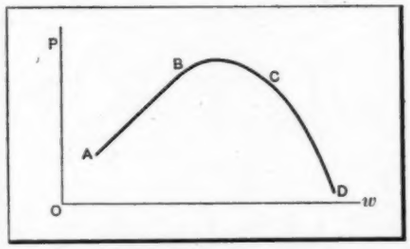


Fig. 3—The motor is capable of running at high speeds if the branch, C D, of the characteristic does not decline too abruptly toward the axis ω

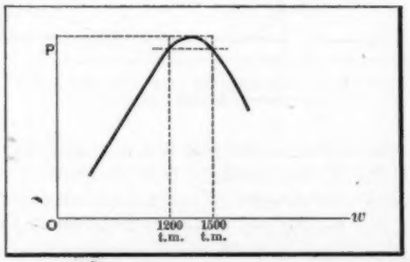


Fig. 4—Pointed characteristic. This denotes a vigorous motor, very powerful, and whose efficiency is usually good. This type, however, lacks stability and the picking up abilities are sometimes slow if the car is driven at a comparatively reduced speed. But a timed acceleration can be made with great vigor and rapidity. Such motors are used in racing.

It often happens that in order to study the characteristic of a motor one cannot do so without considering this limit point; the motor will not in some cases be able to resist the forces of inertia engendered by this speed of rotation.

The examination of this curve of each motor will furnish valuable indications. First of all it will be a means of seeing between what limits the motor can run; and for this purpose it is a simple matter to mark off on the line o x the speeds from which to find this out.

If the curve starts off as in Fig. 2, in a straight line, it will show that the power is for the corresponding speed proportional to the number of revolutions.

The coupled motor runs uniformly, therefore the power per

revolution is likewise uniform. This goes to show that the motor is getting sufficient gas, that the size of the valves is sufficient and that its volume is well filled. It is therefore necessary to endeavor to obtain the rectitude of the characteristic as far as possible along the line; it is an indication of a large amount of power and often good efficiency.

The position of the maximum is not without some importance. If the greatest power is obtained at a high rate of speed the same conclusion can be drawn as before, viz., the motor is being well nourished. Further, it is possible to affirm that the motor is well balanced; for if it were not so as a matter of fact the vibrations set up by the high speed would soon have absorbed the available power.

The Speed Corresponding to the Terminating Point of the Characteristic Will Be Increased in Proportion to the Manner the Motor Is Well Nourished, and Especially if It Is Well Balanced

It is well understood that the carbureter should be correctly regulated for all speeds, and that the ignition should have the requisite amount of advance. If the carbureter chokes, the characteristic will be curtailed without in any way laying the fault at the door of the motor. One of the most interesting points to study is the form of the characteristic in the neighborhood of the maximum point. One finds that in practice (especially in aviation motors) that the motor is called upon to run in the vicinity of the critical speed most of the time. The gear box has no other reason for existence except to allow of the maximum power to be maintained.

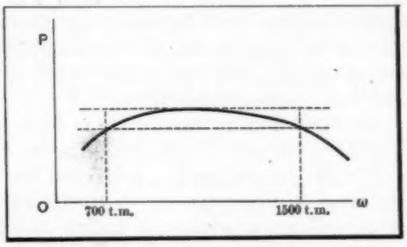


Fig. 5—Flat characteristic. This denotes a soft motor with not much vivacity, but at the same time possessing great elasticity. It takes up the load well, but slowly. As will be seen, the zone of stability is more or less constant between 700 and 1500 revolutions per minute

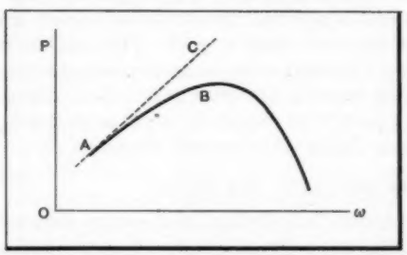


Fig. 6—Poor nourishment or too late opening of the exhaust valve. The characteristic in the portion A B should be much nearer to the tangent of the original A. C. An examination of the managraph card is necessary to complete the diagnosis

If the curve has a decided apex the motor is lacking in stability, as indicated by the rapidly drooping curve shown in Fig. 4, which means that as soon as the speed gets beyond the critical speed the power will drop off in a marked degree.

The weight efficiency, on the other hand, will generally be high, especially if the ascending line of the curve is almost straight. This is what takes place in racing engines. Such motors accelerate quickly, as the effort to be overcome is considerably less than the available power. They are known as "vigorous" motors, and generally have a high compression. On the other hand, they die off with remarkable speed the moment they are allowed to slow down under a load which is too much for their speed. In the hands of a capable driver they can be made to give exceptional results, but in the hands of a novice perform badly. It is well to bear in mind that pointed curves of this description are not sought after for ordinary touring cars. Constant changing of speed would be necessary, and it is the aim of designers to obviate this as much as possible in cars of the present day.

If the characteristic curve, however, is "flat," and presents a broad curve at the maximum point, the motor will possess qualities and defects in the opposite direction. It will have stability; that is to say, its power will remain more or less constant within the large limits of its speed variations. Its weight efficiency will be low and belongs to the motors of the old school. If they are on the soft side they will have as a compensation lasting qualities in service. Motors are like individuals, who, through too great activity, become old before their time. To obtain results from such a motor there is no necessity to be a finished driver.

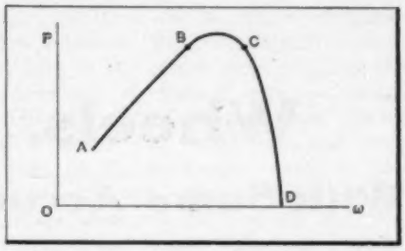


Fig. 7—Badly balanced motor. The nourishment is good, which is shown by the straight line, A B, of the characteristic. But the part C D shows that the motor is not capable of turning fast and that its power falls off abruptly the moment the critical speed is passed

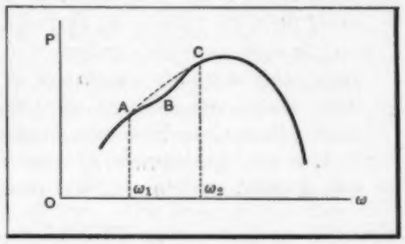


Fig. 8—Characteristic with points of inflection shown at A B C, which denotes an error in dimension or an anomaly in the running of the motor often due to carburation. The characteristic should follow the dotted line, A C

In conclusion it is possible to state what deductions can be drawn from studying the characteristic curve of a motor, and exemplify them by some examples of bad forms of this curve.

Fig. 6 shows a motor that accelerates badly, probably due to the fact that the regulation of the carbureter is incorrect or the amount of clearance of the valves is insufficient at the seats.

Fig. 7 relates to a motor that cannot be accelerated, which is apparently due to want of balance.

Fig. 8, where the characteristic has points of inflection, shows some disorder in the running between the speeds ω_1 and ω_2. The tester should look for the cause of this unusual falling off in power.

Automobiling in Egypt

The land of the Khedive not only boasts of two live automobile clubs, but the country is becoming a favorite touring ground. It must be remembered, however, that should it become necessary to ship a car by train the charges will be exceedingly high.

EGYPT possesses two famous automobile clubs. The leading one is located at 25, Saharia Mada Begh, Cairo, the secretary being M. Jean Prokop. Temporary members (visitors) are required to be introduced by a member of the club. The other notable automobile club is located in Alexandria. The secretary is Mr. A. O. Grafton.

In purchasing return tickets between the principal railway stations in Egypt passengers are allowed four days, including the day the ticket is issued, to use it. But an exception is made in the case of return tickets from Cairo or any railway station north of Cairo to Luxor or any station south of Luxor, such tickets being good for eight days, including the date of issue. But in the event of the desired transportation of automobiles by train it behooves the passenger to arrange plenty of time before the day of starting, as automobiles and all sorts of luggage, except such as is carried by hand, are taxed to the limit. Nothing in the way of big parcels goes free.

There is a fine automobile road from Cairo to the famous Island of Ghezireh, two miles distant, across the Nile. This fashionable suburb affords splendid roads for automobile driving.

Wheels, Ancient and Modern

With Some Account of Their Origin and Manufacture

At the regular meeting of the Royal Society of Arts (London) on April 7 the principal paper, of which the following is a digest, was read by Henry L. Heathcote, B.Sc. The object of the paper was to present an account of some of the most ancient and most modern wheels, to describe their form, the materials used in their construction, and, as far as possible, the methods employed in their manufacture. Mr. Heathcote limited his argument almost exclusively to vehicle wheels, no attempt being made to follow the application of wheels in the many arts which employ them. (First installment.)

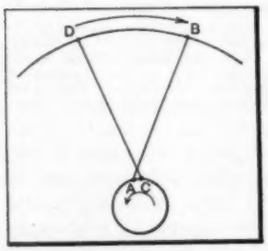


Fig. 1—Element of wire wheel, indicating the stresses in rim and hub under service conditions

THE important advances which were made by the ancients when they began to employ wheels and rotating members in their mechanical contrivances, and the manifold latter-day developments and arts in which they are indispensable, form a chapter so vast as to preclude even the briefest summary.

There is a humanitarian as well as a scientific interest in this study of wheels. Throughout the ages, the use of wheels has played a crucial and ever-active part in the development of the means of intercommunication, now become so rapid and frequent as to form the ineradicable and predominating feature of our time. We know now how closely rapid intercommunication and civilization are bound up together. Bearing this in mind, one need feel no compunction in drawing inferences as to the degree of civilization of the ancient peoples from their wheels. The ancient Egyptians employed wheel vehicles for many purposes, and particularly for war, but the Israelites they held in bondage had no chariots at that time. This stood them in good stead when crossing the Red Sea; the Israelites crossed safely on foot, but, according to Holy Writ, the wheels of the Egyptian chariots became (taking the marginal reading) bound so "that they drave heavily." This, which happened about 1490 B. C., is the earliest record I have found of wheel trouble, but for which the Israelites might never have reached the Promised Land.

Origin and Evolution of the Wheel

The actual origin and inventor of the wheel are lost in the mists of antiquity. The use of it appears to have originated in the East and spread westwards. Doubtless the nomadic tribes would be among the first to discover the advantages of wheels. This may account for their widespread use at a very early date. The oldest Indian literature mentions wheels, showing their use as parts of vehicles as far back as 1700 B. C. This is about the date of the first reference to wheels in Holy Writ.

Those who seem most competent to judge agree that the wheel took its origin from the cylindrical tree-trunks which were placed as rollers under a load. Probably the first vehicle was the sledge, the rollers being used when heavy masses had to be drawn. Rollers being in demand, and heavy ones being difficult to handle, it is likely that long ones were cut up to make small ones. The desirability of fixing these would soon become felt. Precisely how this was done we do not know, but conjecture suggests that the middle may have been grooved out to permit of a staple or pegs on the sledge engaging with the groove and preventing it running along or sideways. This groove may have come to extend the whole width of the sledge. A natural sequence would be to build this form up out of three parts—two disc-wheels and one axle, the axle being prevented by pegs from rolling away underneath the cart. Solid wheels were used by the less civilized nations of Asia Minor, and on the farm-carts of classic times. Virgil refers to solid wheels built up of three planks held together by an iron hoop, and this form is said to be still in use in Southern Italy and to make a loud creaking noise as it turns. Some of the old Chinese pictures show solid wheels with holes cut out, possibly for lightness, but more probably to admit a pole for skidding the wheel on a decline. This is an ancient method of braking, from which has arisen the phrase "to put one's spoke into another man's wheel."

As late as thirty years ago bullock carts were in use in Lisbon with only two such pegs to keep the axle in position. The body of the cart could be lifted right off the wheels, and even now solid wheels and axle are hewn in one piece out of tree trunks and used for carts in the northern provinces of India. Solid wheels with iron axles are also used.

Splitting must have been a serious cause of trouble in ancient disc wheels. Some that are still extant, dating from 1550 B. C., show bad splits and leathern thongs binding the parts together. Segments of tree trunks would necessarily have a limited diameter, and though the large ones would prove better runners on rough roads they would be more likely to split. This may have led to planks being nailed together, some crosswise, and the survival of the fittest would account for their persistence. From this to radial planks cut parallel to the grain is not a long step, and from radial planks to spokes is a natural sequence.

The Wheel and Religion

In India the wheel entered largely into the native rites of worship. Some of the religious writings contain an account of a mystic wheel with a nave and tire and a thousand spokes. The connection between the wheel and religion has been investigated by W. Simpson. The wheel was symbolic of the apparent rotation of the sun and stars, the worship of which led to the use of praying wheels, circumambulation, processions, and other "circular" rites.

At this time, to speak of a man as being "like a wheel" was as complimentary as it now is uncomplimentary to call anyone a roué. It is interesting to note, in passing, that this degeneration probably arises out of the connection between vice and the use of the wheel as an instrument of torture.

It appears that India was not the only place where the wheel was held in veneration. M. Gadioz has discovered that there was a deity whose most prominent symbol was the wheel. Most of the figures of this god of the wheel are found upon French soil. The oldest represent Saturn holding up an eight-spoked wheel in the left hand; many show a six-spoked wheel. These date back to Teutonic times. Later the Gaulish Wheel-God became Romanized, and the figures take the form of a Roman holding a ten-spoked wheel. Altars have been found with an eight-spoked wheel carved on them. The Gauls of antiquity wore small wheels as amulets, some of which are to be seen in the British Museum, and are of bronze and about the size of

a penny. Other wheel amulets were of gold, silver, lead and even terra cotta. From the number that have been found in rivers and at fords it has been inferred that they were offerings to pacify the River-God and procure a safe crossing. Most of these have four spokes and a heavy rim.

The form of punishment known as breaking on the wheel is a survival of sacrificing to the Sun-God or Wheel-God, just as hanging is a survival of sacrificing to the Wind-God, and the institution of this horrible custom in France is doubtless connected with their greater familiarity with the Wheel-God. In 1534 this was the treatment reserved for highway robbers: The condemned was first placed on a sort of St. Andrew's Cross with his limbs hanging between the four pieces of wood. The executioner then broke his arms, fore-arms, thighs, legs and chest. The victim was then attached to the rim of a small coach wheel suspended in the air by a thick post, the broken arms and legs were tied together behind his back and the wheel rotated.

Chariot Wheels

We will now consider some of the early wheels a little more closely. The use of these for chariots led to a very advanced development even at a very early date.

The invention of chariots is ascribed by some to Erichthonius, son of Hephaestus and King of Athens, who flourished about 1460 B. C.; by others to the priest Trochilus or his son, Triptolemus. Homer described Telemachus as traveling from Pylos to Sparta in a chariot provided for him by Nestor:

> The rage of thirst and hunger now suppress'd,
> The monarch turns him to his royal guest;
> And for the promis'd journey bids prepare,
> The smooth-haired horses, and the rapid car.

Probably, however, chariots had long before this been in use among the Egyptians. In Holy Writ we find two references to Egyptian chariots in use about 1715-1705 B. C. Chariots were, with very few exceptions, two-wheeled vehicles.

Design of Early Wheels

EGYPTIAN WHEELS.—The Egyptian chariots, as shown by their sculptures, were easily carried by one man, and were, therefore, quite light. It is worth noticing, too, that the wheels were placed as far back as possible. In this position part of the load is borne by the horses. Since the chariot was so light this design could scarcely have been chosen to save them; the object must have been to lessen the load on the wheels and to reduce the shock transmitted to the rider.

The first slide shows a wheel found in the tomb of the Egyptian Tuiyu (1583 B. C.), now in the Cairo Museum. Round the rim is placed a leather tire, so that the mighty dead should be protected against the shocks of the road when traveling during his second time on earth.

The Egyptian war chariots generally have six spokes, a few have eight and others twelve; their private cars had only four. The spokes were usually round. The felloes were strengthened at the joints with bronze or brass bands, and the rim was a metal hoop. An Egyptian wheel has been found having a wooden tire in six butt-ended segments and a felloe in six segments lapped at their ends. The rim segments have four slots near the felloe, and bands of rawhide are passed through these slots to bind the rim and felloe segments together. The spokes are round and tapering near the nave and square and tapering near the rim. They are provided with dowels at each end and a slot near the nave end, probably for a metal band. The diameter of this wheel is 3 feet 1 inch. In Egyptian wheels the axle-trees do not rotate, and the wheels are kept on by small linch-pins.

One of the Egyptian paintings in the British Museum shows a wheel with a nave in one piece and sockets for the six round spokes. At the end of each spoke is a T-piece, which forms a socket both for the spokes and for the segments of the tire. There is also an Egyptian wheel in the British Museum. This is of wood, disc-shaped, flat on both sides and probably off a cart or truck used about 1550 B. C. It is still in excellent preservation and is about 2 feet in diameter, about 7 inches thick, with a cylindrical hole at the center about 7 inches in diameter. It appears to have been cut from a solid tree trunk.

ASSYRIAN WHEELS.—The Assyrian sculptures show three forms of wheel: (1) Four-spoked, with heavy rims and tires for heavy carriages. Some of the hand-carts shown in the sculptures have four very broad spokes, which look like boards. (2) Eight-spoked, with three concentric rings in the rim, the outermost being the tire proper, and spokes fitting into sockets at the nave. These were for chariots. (3) Wheels with nail tires. This slide shows the chariot of an Assyrian king, Assurbanipal (date 668-626 B. C.). Judging from the height of the horses and size of the men, these wheels must be from 5 to 6 feet in diameter. Note the tapering spokes, heavy-studded tire and four gaiters to keep the tire on the rim. Occasionally we come across Assyrian wheels with twelve spokes. This slide shows a warrior's chariot with captives in front. The wheel is not more than 3 feet 6 inches to 4 feet in diameter.

The next slide shows the hunting chariot of the Assyrian king Assurnasirpal. These wheels are much smaller than the last, probably not more than 2 feet in diameter. You will note how very massive the tire parts are in these wheels. The six spokes are comparatively slender. This suggests that they were either made of metal or that they presented their edges toward the outside. The tires are generally built up of four, five or six segments, the joints being sometimes at the spokes and sometimes between.

PERSIAN WHEELS.—The Persian relievos also show an advanced development. This slide shows a wheel with twelve ornamental spokes fitting into a rim carrying a studded tire. These studs were doubtless intended to keep the metal tire on the wooden felloe, but their number suggests strongly that, even in those very early times, they appreciated the need for some non-skid device.

Among the discoveries in South Germany are some iron tires, all that remains of the chariot buried with some dead warrior. These tires are about 40 inches in diameter and are covered with radial spikes on the inside. On the outside are still left the overlapping scale-like heads of nails, just like the Assyrian and Persian tires we have seen on the screen.

Cyrus, King of Persia about 560 B. C., made several improvements in chariots and chariot wheels. We are told that he noticed how easily the wheels broke and built them stronger. He lengthened the axle to give chariots more rigidity, and at each axle end of the war chariots he fixed a horizontal scythe, and underneath the chariot other scythes with their points turned toward earth.

GRECIAN WHEELS.—The Greeks preferred wheels with four spokes. Some Greek vases (800-500 B. C.) show racing chariots with wheels having four flat spokes. This slide is from a terra-cotta relief and shows Paris abducting Helen. You will note how very crude this wheel is compared with the approximately contemporaneous Assyrian and Persian examples. The flat side of some Grecian spokes is wider at the nave than at the rim and parallel to the axle. Strengthening pieces appear always to be used at the junction of the rim and spokes, and the tires are in segments—generally four or more—of flexible wood kept in place by an outer iron tire. This slide shows a racing chariot with eight spokes. Like the former, this Grecian wheel is quite small, probably not more than 20 inches in diameter. The slide shows the reins tied round the body of the charioteer, which, as you may remember, was their custom. The metæ are the conical posts which marked the turning point; the spina is the low wall (or spine) running down the middle of the racecourse and round which the competitors had to drive. One vase (about 700 B. C.) shows a racing chariot with two spokes and two bars at right angles to these from one side of the rim to the other, but not passing through the nave. These wheels were made to rotate on the axle. The nave had an external ring of iron, into which the spokes fitted, and a flat ring

supported by a linch-pin prevented the wheels from coming off. Their diameter was for the most part under 30 inches, and the two wheels were nearly 7 feet apart.

Materials Used in Ancient Wheels

The early Egyptian carriage wheels were made of wood, and some of these are still in existence. Their sculptures show their methods of bending the felloes and rims, spoke making and wheel building. The spokes were shaved to make them round and smooth. The Egyptians knew how to produce iron as far back as 3733 B. C., but it was among the Assyrians that this metal was most freely used for the production of tools, weapons, and ornaments, and the Egyptians probably learned many of the uses of iron from them. We have already seen how the Assyrians applied their skill in metal working to wheel making, and doubtless their progress in this direction is closely connected with their military success.

According to Holy Writ, the wheels of Solomon's laver carriages (about 1000 B. C.) were bronze. We read: "Their axle trees and their naves and their felloes and their spokes were all molten." At the time of Judah (about 1440 B. C.) we read of the dwellers in the valleys of Palestine having chariots of iron. This probably refers to forged iron; cast iron was probably not known till after the time of Homer (about 900 B. C.). The first Grecian wheels were made of oak. This slide shows the wheel of a funeral car, which appears to be made entirely of wood, except for the tire. The later Grecian wheels were made entirely of bronze. The next slide shows a bronze two-horse chariot. Homer speaks with enthusiasm of copper tires (Iliad 5, 722 *et seq.*):

> Quickly Hebe fixed on the chariot the rounded wheels of copper, eight spoked, around an iron axle; their felloes were indeed of gold, imperishable, but around tires of copper were firmly fitted, a wonder to behold.

Whether this was a detachable spare wheel that the Goddess of Youth was fitting to the chariot we are not told, but it is interesting to note how gold felloes pale into insignificance beside copper tires that did not easily come off.

There are some antique bronze chariot wheels still in existence at Toulouse. These are 54 centimeters in diameter and have naves 40 centimetres long and 7 centimetres in diameter. The spokes are five in number, and there are deep recesses in the felloes to take the tires. The rivets used for fastening on the wooden tires can still be seen in the felloes.

Of early British wheels I have no examples to show. Cæsar, you may remember, found our ancestors possessed of war chariots which they managed with great skill, implying a long previous acquaintance with the use and manufacture of wheels.

Ancient Wheels—General Considerations

Before leaving these ancient wheels it is, perhaps, worth pausing a moment to consider their main features from one or two present-day points of view—*e.g.*, strength, serviceability, and appearance. In those times torque would only be applied to a wheel in its plane when occasion arose to put the shoulder to the wheel. They were not built to transmit torque, so when the Egyptian wheels sank in the sand of the Red Sea they gave trouble. The same must have happened in many other cases. Every time a car or chariot curved to the right or left a thrust on the rim would be developed perpendicular to the plane of the wheel, its magnitude depending on the weight, speed and flexibility of the car, the radius of the curve and the character of the ground. The tendency of this would be to break the spokes near the nave. In overcoming this there are two paths open to the designer, one is to dish the wheel, the other to strengthen the rim—the former is the modern way, the latter was the method adopted by the ancients. The Greeks, as we have already noticed, provided strength to resist side thrusts by sometimes employing spokes wider near the nave and with their flat side parallel to the axle. This was also the method employed for building one of the London Omnibus Company's wheels which came under my notice a few years ago.

With regard to serviceability it is probable that these ancient wheels would work loose where the spokes enter the felloe and nave. This would lead to loud creaking and groaning, and probably partly explains why we read of the mother of Sisera listening for the noise of his chariot wheels and not for the sound of his horses' hoofs. No doubt the sockets employed in the more recent of the ancient wheels served to strengthen the joints and minimize the noise.

With regard to appearance, even in very early times they preferred wheels with more spokes (eight and twelve) for war and State purposes. Where the wealth of Solomon made it possible bronze wheels were preferred, and among the æsthetic Greeks the all-bronze wheel found considerable favor.

The foregoing account, incomplete though it is, will be sufficient to show that there was considerable variation in the design and materials employed by the ancients in wheel making. Even the wheels of the same country differed considerably among themselves. As early as 500 B. C. wheels had reached a very advanced stage of development even in Europe, due partly to their use in war, partly to the sports of the Stadium, and partly to the rough roads and tracks which they had to traverse.

Modern Wheels

The Suspension Wheel.—We will now pass on to the next stage in wheel development, which dates from the use of bicycles. During this gap of about 2500 years the only changes of any importance were the dishing of wheels to resist lateral stresses due to ruts and rounding corners, and arranging the spokes on two cones instead of one. This last was done as early as 1828, and is still used at Woolwich Arsenal in building ambulance wagon wheels. Strange though it may appear, wheels were not used generally for facilitating transit in Britain till comparatively recent times. The very first carriage was made for Queen Elizabeth in 1568; the first that plied for hire in London were in 1625, and the first stage coaches were in 1659. Broadly speaking, all the early wheels were compression wheels with radial spokes. The introduction of the suspension wheel for bicycles marked a great advance in the shock-absorbing powers of wheels. The first bicycle wheels were compression wheels, and had wooden spokes and rim with an iron tire. The wheels were just ordinary light carriage wheels. The curved member connecting the back axle to the top of the front wheel is not altogether unlike that used in the chariots we have been looking at. Later bicycle wheels had radial wire spokes, which, being in tension, kept the rim in position. In the older wheels the rim was normally in tension, and the spokes and hub in compression. In a suspension wheel the spokes and hub are in extension, while the rim is in compression. It is a common, though not unnatural error to suppose that the spokes of a modern bicycle wheel are sometimes in compression. As a matter of fact, they are always in tension, even those between the hub and the ground, when a heavy rider is in the saddle.

A suspension wheel has very little in common with a suspension bridge. If a number of contiguous canal bridges were built in a circle right round the earth, and the earth cored out, the resulting structure would much resemble a large wooden wheel, in which the compression due to the shrunk-on rim was replaced by that due to gravity. A like series of suspension bridges would, however, be quite unlike a wire wheel. In the latter there are no members whatever in compression between the rim and the hub, and its structure is more nearly related to that of a trellis which can be prevented from falling in in one direction by compression at right angles.

Fig. 1 represents one element of a wire wheel. If tension be applied to the spokes, the rim and hub would move towards one another were it not for the effect of the other segments; the resistance to the compression forces in the rim, and to the bursting stress in the hub shell prevents this movement. When compression is applied between the bottom of the rim and the hub-center of such a wheel the tension of each spoke will, if the rim is inflexible, decrease proportionately to the cosine of

the angle between the spoke, or, rather, the projection of the spoke in the plane of the wheel, and the direction of compression. When the cosine becomes negative, as when the spoke is above its horizontal position, the decrease becomes, of course, an increase, having its maximum of spokes on the upper part of the wheel pointing in the direction of the compression. Obviously, the spoke tension should never fall to zero nor rise above the elastic limit, and these limits help to regulate the choice of the initial spoke tension.

THE TANGENT-SPOKE WHEEL.—The tangent-spoke wheel, in which the spokes are tangent to a circle having its center at the axle and are not normal to the rim, probably owes its origin to the curved arms used in driving pulleys and fly-wheels for transmitting considerable torque. This slide shows a bicycle of the transition stage—most of its spokes are radial—or nearly so; the rest are tangent to a circle of large diameter. The next slide shows an early tangent-spoke bicycle wheel, in which all the spokes are tangent to the same circle. Both ancient and modern radial-spoke wheels are capable of transmitting a certain amount of torque, but the amount is limited, and depends not only on the bending strength of the spoke, but on the rigidity of its attachment to both rim and hub. Since no material has an infinite elasticity, it follows that however thick the spokes may be there must be a certain amount of twist of the hub (in the plane of the wheel) relatively to the rim, or no drive can be transmitted. When the torque is considerable—as in a motor-car rear wheel—the actual twist sooner or later rises above that corresponding to the elastic limit at some or all of the spoke attachments, and this leads to gradual loss of rigidity and to creaking, and, in some cases, even to charring owing to rubbing. In a radial-spoke bicycle wheel subjected to a torque in its plane, the hub must rotate relatively to the rim until the spokes are tangent to a small circle. If the average tension on the N spokes is t, when transmitting the torque T the tangent circle will have a radius—

$$r = \frac{T}{Nt} \text{ approx.}$$

Applying this to a bicycle wheel with fifty spokes, and assuming the pull in the chain to be 300 pounds (which is about that due to a vigorous jerk), the chain ring to be 3 inches diameter and the hub flange 1 3-4 inches diameter, if the average final spoke tension be 80 pounds, it is easy to show that the hub will twist 7.35 degrees relatively to the rim.

In a tangent-spoke wheel the hub must also turn relatively to the rim, but the angular movement is far less. In this case torque has the effect of increasing the tension on half the spokes and decreasing it on the other half. Reverting to Fig. 1, if the initial tension on AB and CD be t and the added and subtracted tension be p, the torque due to

AB will be $(t+p)\ r$, and to
CD will be $(t-p)\ r$.

The difference of these is the resultant torque due to this element—

$$\therefore \text{ Total torque} = \frac{N}{2} \times (tr + pr - tr + pr)$$

$$\therefore T = Npr.$$

Which is independent of the initial tension t provided $(t-p)$ is a positive quantity.

If the tangent circle be of the same diameter as the flange in the previous case, it is easy to show that, for fifteen-gauge spokes elasticity 10,000 tons per square inch, the twist of the hub for the same push as before will be 0.11 degrees, or about one-seventieth that with radial spokes. This greater rigidity in torque transmission places the tangent-spoke suspension wheel far ahead of both radial compression and radial tension wheels. It has long been universally used for bicycles and motor-bicycles, and is now enjoying popularity in its application to motor cars.

The radial wheel has to be subjected to great radial tension or compression in order to impart the necessary torque rigidity. In the tangent wheel the necessary torque rigidity can be attained without imparting excessive radial rigidity. As a result of this the tangent suspension wheel can be made capable of absorbing shock. A comparison of a suspension wheel with a section of a tire will bring this out more clearly.

Waldo Improving Fire Equipment

Chief Lally Advocates Garage Fire Prevention

Automobile fire-fighting equipment is being examined for use in New York City under the impetus that Commissioner Waldo is giving the activities of the Department. Chief Thomas Lally, at the Brooklyn headquarters, is pushing experiments upon the methods that his wide and successful experience tells him are more to the point than responding to an alarm. Between fire prevention and inside fire-fighting as advocated by the "Chief," and the purchase and use of automobile equipment such as will permit of promptly responding to alarms and the effective use of the high-pressure system that is now in shape to take advantage of in this exacting work, the situation looks promising.

SCIENTIFIC fire prevention is the subject that Chief Thomas Lally took for his theme in his discussion of fire-fighting before the American Society of Architects at its meeting in Brooklyn on Monday night, and the scope of the discussion proves to be of interest to the automobile fraternity on account of the suggestions that were offered for the prevention of disastrous fires in garages. The chief said: "'No Smoking' is a good sign to put in a conspicuous place in every building, but it must not be inferred that this sign will put out a fire in a garage if a thoughtless person throws a lighted match on the floor and it lands in a heap of oil-soaked waste. Before presenting details of the fire-fighting problem in garages it will be to the point to recount the difficulties and note what the nature of the obstacles are and how stubbornly they resist treatment.

"Remembering that garage floors, and repair-shop floors in particular, are frequently heavily coated with grease, it must be apparent to the thinking citizen that when a fire is started under such conditions water will be of no value, unless to help spread the flame. Unfortunately, grease and oil remain on the garage floor all the year round, due to the fact that washing the floor with water fails to remove them. There is only one way to get rid of the grease on the floor, particularly in view of the fact that it penetrates to a depth into the chinks and boards of which the floors are too frequently made, and that is to saponify the grease. In order to reduce the accumulations of oil and grease to soap before they can be removed it is necessary to use about 10 pounds of caustic soda to 75 pounds of fat, adding water to make a solution, it being true, of course, that an equivalent amount of alkali in the form of soap will suffice for

the purpose; but the point to be made here is that saponification is essential to the success of the project. It would be an excellent idea were it compulsory, on the part of keepers of garages, to wash down the floors with a caustic solution at least once a week in order to remove the grease from the floors or wherever it is permitted to accumulate.

Fire-Prevention in Garages Is a Mere Matter of Supplying Enough Fresh Air to Prevent the Accumulation of Explosive Mixtures

"Gasoline, as it is used for automobile fuel, if it is allowed to escape from its receptacles, will vaporize in the air, and, as experience has shown, the time is likely to come, even in well-maintained establishments, when some gasoline will escape and an explosive mixture will obtain. This does not always mean that there will be a fire—it is necessary to inflame the mixture. We may call it a coincidence if a man comes along, strikes a light for his cigarette, and throws the match, while it is still burning, into the medium of explosive mixture, and the victim will be fortunate if he lives to relate the circumstances. If there are 200 automobiles stored in a building, and each car has a gasoline tank with a small amount of gasoline in it (say one pound of liquid), there will be 4,000,000 British thermal units of heat in this body of gasoline, although the keeper of the garage will say, in all sincerity, that there is no gasoline in the building. In the meantime, it is fair to say that there is scarcely a gasoline tank on a car that will not hold more or less a pound of gasoline (partly on the inner surfaces, and for the rest, in pockets) after the tank is drained out. If one tank leaks and 20,000 British thermal units of heat are so placed that a match will do the rest, the balance of the heat (4,000,000 British thermal units) will be so placed that a serious conflagration is the only expectation.

"Looking at the grease on the floor of a garage with the experienced eye of a fireman, it is merely to point out that each square yard of the floor stores 20,000 British thermal units of heat in the form of grease, if the floor is not washed down by a solution that will saponify the grease, and, unfortunately, this storehouse of heat is in the most likely form to make a hot fire.

"Remembering that waste (shredded cotton fabric) is perfectly capable of combining with oil to form an explosive, the nature of which is akin to gun-cotton; remembering also that the average garage employee can scarcely be expected to appreciate the fine points attending this condition, it remains to observe that waste is used in the cleaning of the parts of cars that are undergoing repair and in wiping machinery under ordinary conditions, and it is only natural that the used waste will be soaked with oil. While the regulations provide that receptacles be employed for the storage of this oil-soaked waste the fact remains that the placing of the used waste in the receptacles, if they are provided for the purpose, depends upon the thoughtfulness of the workmen, who, as before stated, are scarcely likely to appreciate the dangers that attend a little carelessness in this regard.

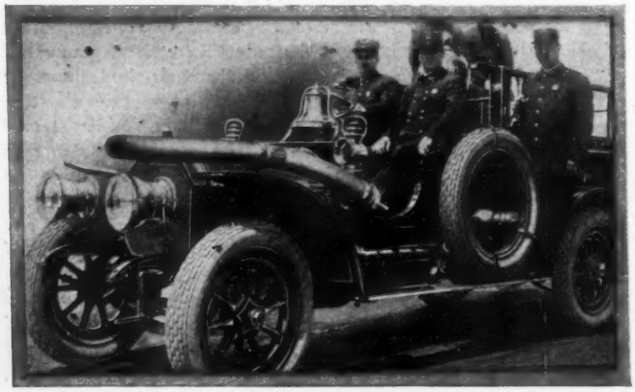


Fig. 1—Illustrating a fire apparatus of the automobile type fitted with Republic tires that are large enough to properly do the work

Fig. 2—Rhinelander Waldo, Fire Commissioner of Greater New York

"A pound of oil-soaked waste may hold over 50,000 British thermal units of heat in the most acceptable form for rapid combustion, in addition to a peculiar ability to undergo chemical change, thereby forming a self-igniting compound at the ordinary temperature, and this important consideration, attended by the other hazardous circumstances, leads up to the conclusion that efforts to prevent fires in garages and like establishments offer unusual difficulties, thus suggesting that some plan should be adopted which will be automatic as well as efficacious in the quenching of the flame, preferably a plan that will depend for its success upon the presence of a fire.

When We Can Depend Upon Fire to Put Out a Fire, Prevention in Its Most Efficacious Form Will Be a Reality

"Granting that water when turned onto a conflagration in an establishment that is more or less soaked with oil, particularly if gasoline is present in quantity and free, offers no promise of success, it remain for the fire department to either isolate the building, thus preventing the fire from spreading, without any thought of saving the structure, or make an effort at fire prevention that will promise success.

"Looking toward fire prevention as being the best strategy, we are reminded of the peculiar ability of certain forms of chemicals for the choking of flames, it being the case that these chemicals, in the form of salts, when heated, or fused, as it is called, evolve great volumes of gaseous media, free from free oxygen, and this gas, so formed, displaces all of the air in the vicinity of the fire, after which the flame dies out, due to the fact that it can get no more oxygen, which is necessary to its propagation.

"Making a fire to put out a fire, then, while it sounds paradoxical, is a perfectly feasible undertaking. Were a building stored with ammonia nitrate, or were this materal present in sufficient quantity in the form of sulphate of ammonia, a fire would be quite out of the question, due to the fact that the fusing of these ammonia salts would produce vast quantities of nitrous oxide gases that would hover over the flame, completely fill the surrounding space, displacing oxygen, resulting in the quenching of the flame.

Fig. 3—Chief Thomas Lally, of the New York Fire Department, taken in front of the Jay street headquarters, Brooklyn

"Fortunately, the ability of these ammonia salts to produce large volumes of non-inflammable gas is very marked. It is not too much to expect that a single barrel of the salts, if placed on the floor of a garage, when heated by a fire that may be started in the vicinity, since it fuses at a low temperature, will produce a sufficient volume of heavy black smoke to displace all of the air on that floor and blanket the fire. The cost of the material is from 5 to 12 cents per pound, depending upon whether or not it is a sulphate or a nitrate, and upon the degrees of purity, so that it would be no hardship to the owner of a garage or a machine-shop were he required to conform to a wise preventive regulation which might take on the form of compelling the storage, under efficacious conditions, of a sufficient quantity of non-inflammable, gas-producing chemicals to accomplish the purpose of fire prevention.

"But garages and machine shops are not the only establishments that require attention of this sort. Some of the most severe fires in Brooklyn, and, I understand, elsewhere, are due to the burning of storage warehouses, filled with paints, oils, varnishes and other inflammable materials, and to the catching on fire of oil-distilling plants. An alarm, if it is sounded in the vicinity of any such establishments, brings out the whole department without ado, and apprehension prevails among the general staff during the entire period of a conflagration of this character owing to the fact that a fireman's weapon is water, which, when turned onto burning oil, seems to feed the angry flame.

Scientific Fire Prevention Is an Immediate Possibility Without Inducing a Hardship Such as Will Generate the Lasting Opposition of Property Owners

"Blaming men for the vagaries of natural phenomena is the device of the novice whose experience does not permit him to suggest a remedy on an equitable basis. Depending upon inspectors to enforce impossible laws is like telling the wind not to blow, whereas the proper course is to trim sail to the passing of the breeze. If the problem of fire prevention is attacked on a scientific basis it will still be desirable to put 'No Smoking' signs on the walls in conspicuous places, construct buildings so that they will be 'slow-burning' or 'fireproof,' and do all of the other things that experience has proven to be wise and far-seeing. But when a fire starts, if there are explosives or highly inflammable materials in quantity within the structure, it must be remembered that the building of great strength becomes an extra hazard just as a bomb loaded with powder is far more devastating than an equal amount of powder if it is set on fire in the open. The strength of the shell, let it be of a bomb or a building, regulates the force of the explosion.

"From what has been said, if the principle of fire prevention utilizing natural forces is the right one to follow up, it still remains to level off the incongruities in the regulations to whatever extent experience may find them wanting, and then to apply the more scientific methods for the prevention of fire, rather with the expectation that the spreading of the flame to uncontrollable proportions, due to the lack of ability of water, under certain conditions, will be prevented. The subjects for further consideration, under the circumstances, may be reduced to brief form as follows:

"(a) Prevent the formation of explosive mixtures in garages and like establishments by pumping fresh air into the building at a rate which will displace the contaminating product, which might require the replacing of all of the air in the building, say, four times per hour. A relatively small ventilating wheel, if operated continuously under proper conditions, will effectively accomplish this work in a building of some proportion.

"(b) The use of a 'pit' or other pocket in a garage is depreciated in view of the fact that vapor of gasoline forming an explosive mixture when added to air is heavier than the air undiluted, and this vapor will settle into a pit or a pocket and remain there for several days, awaiting the coming of the history-making match.

"(c) Sewer connections should be so contrived that in the washing of the floor, if gasoline or other oil is mingled with the drainage, the vapor of gasoline, as it rises out of the liquid mass, will be entrained in an air current to kill its explosive ability and to take it away to the atmosphere, preferably above, thus drawing its teeth, from the point of view of further damage.

"(d) Saponifying the grease on the floor, under regulated conditions, using a sufficient measure of caustic material in view of the quantity of grease present in a given case to dissolve the grease in order that it will be taken up by the water, remembering that grease is not soluble in water, whereas soap is dissolved therein, is a reasonable measure.

"(e) Appointing a commission for the purpose of determining the best form of chemical and the required quantity thereof for the production of a smoke-blanket that will quench a flame after a fire has been started, thereby utilizing the heat of the flame for the fusing of the chemical, offers excellent possibilities.

"In conclusion, it may not be unfair to say that fire prevention is at the bottom of the fair showing that has been made in Brooklyn in the last few years, with freedom from loss of life of the firemen who are responsible for the good work, which

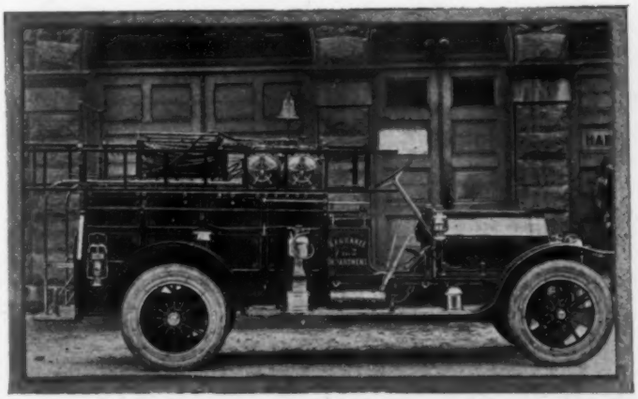


Fig. 4—Kissel Kar "Chemical," made at Hartford, Wis., for the fire department at Kankakee, Ill.

prevention thus far has been in the direction of carrying out the mandate of the department covering the subject of combustibles and their storage; but investigation, coupled with experiences gained, would lead to the conclusion that the door leading to the scientific fire-fighting problem has barely been opened.

Fire-fighting at the Oil Distilleries in Brooklyn Where Gasoline Is Made Is Being Reduced to a Scientific Level

The average citizen looks upon a fire among the "oil tanks" as a lasting and unquenchable affair, which is a matter of a fierce conflagration for several days unless the supply of oil gives out, but the new principle of fire-fighting is being worked out at the Brooklyn plant of the Standard Oil Company in accordance with extended experimentation, so that the success of the new plan is assured. Chief Lally accompanied by the Editor of THE AUTOMOBILE went to the Brooklyn plant of the Standard Oil Company on the afternoon of April 25, and in the course of the visit observed that the new method which will reduce the Brooklyn fire hazard as far as the burning of gasoline and lubricating oil is concerned to a practical zero has been brought to a successful issue.

It has been found that sulphate of aluminum and bicarbonate of soda, when used under proper conditions, will "pave" over a tank of oil and shut out the oxygen as supplied with the air so that the flame is quenched and, in the common parlance, the fire is "put out." In the use of these compounds the sulphate of aluminum is dissolved in water, to which is added nearly the same amount of licorice. The bicarbonate of soda is likewise dissolved in water in a separate tank. The two liquids, stored in tanks adjacent to the zones to be protected, are pumped into the burning oil in tanks, through separate lines of piping, and as these liquids mingle with each other they "saponify," but the presence of the licorice has the effect of binding the soap bubbles into a relating mass, and the experiments under fire conditions in actual oil-tanks show that when these two liquids come together they produce an enormous quantity of froth that completely engulfs the burning oil so that within fifteen minutes after an oil-tank is supplied with this material, no matter how fiercely the fire may be raging, it is quenched, and the danger of the fire spreading is therefore eliminated by supplying the remaining tanks with their quota of the fire-preventing material.

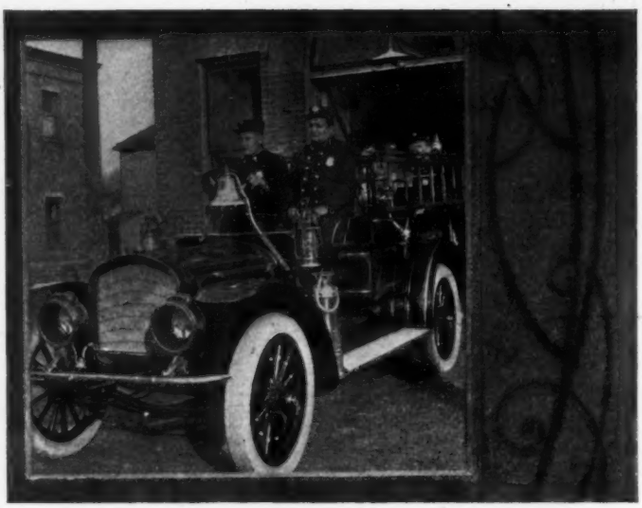


Fig. 6—Rambler hose and fire patrol wagon leaving the station at Kenosha, Wis.

In discussing this matter in the interview with Chief Lally, he pointed out that the oil distilleries were formerly a great menace to life and property, due to the close nesting of the oil-tanks, and to the extreme difficulty involved in quenching the flame when it is once started. It is his belief that the new era of fire-fighting is here, and that the dangers, of which a new crop came with the automobile as an instrument of transportation, are, in a way, to be alleviated. The great question will come in getting the public to realize that a fire hazard assumes serious proportions only when the instruments available are ineffectual. As the "Chief" states, the spectacular fire-fighter who stands in the fifteenth story window while one of his assistants turns the searchlight upon him is an incident of the past. Under scientific conditions, studying the problem on its merit, it is a reasonable expectation that garages and other places of like character will be relieved of undue and hampering regulations, and the measure of safety will be adequate from every point of view, using modifications of the very method that puts out a fire in an oil-tank within a few minutes no matter how fierce the fire may be.

Fig. 5—Robinson automobile fire engine in the service of the St. Louis Fire Department

Ebonite for Ignition Work

The following is a formula for making ebonite:—Melt and mix 100 parts of indiarubber, 45 parts of sulphur, and 10 parts of gutta percha. Run in a suitable mould that is not affected by sulphur, and expose for two hours to a temperature of 600 deg. Fah.—*Motor Trader.*

Fig. 7—Commer-Car six-cylinder fire tender, used by the London (Eng.) County Council

Fire Officials Test Knox Engines

Officials of the New York Fire Department witnessed a preliminary test of the new Knox fire engine ordered for the department some time ago. The test was conducted at Springfield, Mass., and, while it did not prove conclusive at the time, the company is now changing the gears so as to attain a trifle more water-throwing capacity for the pump.

The time for the final test of the machine has not been set definitely, but will take place in the near future.

Chief John P. Howe and Captains Henry and Demarest, of the New York department, went to Springfield to witness the test and took voluminous notes of its progress.

The engine was given two periods of action of about five minutes each. Under the requirements the pump must throw 700 gallons of water a minute, and owing to the small gears the amount actually thrown was 688 gallons at maximum. The company is adding two more teeth to the high gear and expects that this will add at least 5 per cent. to the efficiency of the pump.

The fire engine is propelled by a six-cylinder motor, 5 1-2 by 5 inches, and rated at 72.6 horsepower. The pump is chain driven from the main shafting and is of the reciprocating type, having two cylinders, 4 3-4 by 8 inches.

Contained in the same vehicle is a hose carrier of considerable capacity. The whole apparatus weighs about 7500 pounds, considerably lighter than the ordinary type of combination engine, and the contract price is $8,500.

The regular test will be given the engine in New York, where it will be submitted to a severe running trial and a pumping trial of four hours' duration. There was much enthusiasm apparent in the department as to the performance of the Knox in the preliminary test despite the fact that the pumpage was not quite up to the mark.

Similar engines to the one tested by the New York officials have been ordered for Savannah, Ga., and Lexington, Ky.

A giant Couple-Gear hook and ladder has been ordered for the department for delivery about July 1, and at the present time there are fifty pieces of motor-driven fire apparatus building in various automobile plants for the protection of New York City.

The New York officials were much interested and not a little amused at the new fire department building now in course of construction at Springfield. They praised it in every way except as to the dormitories. These are arranged so that each man has a small room separate from all the rest, and when the alarm sounds he has to run out of his room into a corridor and slide from there to the engine room.

The officers say that such construction would not do in New York, no matter how much it might add to the privacy and comfort of the men.

Lack of Trucks a Menace to Army

Pittsburg, Pa., April 24—Captain J. Clyde Miller, an officer of the Eighteenth Pennsylvania Infantry, who returned from a tour of duty with the army corps now under mobilization on the Mexican frontier, declares that it would be suicidal for the United States to engage in war at this time on account of the woeful lack of transportation.

Captain Miller says that in the event of war with Japan this country would be doomed to witness a series of disasters for six months because of the scarcity of wagon trains and field guns.

In modern warfare the term "wagon train" spells "automobile" to all the nations of the earth except the United States.

Captain Miller says that the army officers are fully conversant with conditions and that the fault lies not with them but with the superannuated departmental heads and a complacent Congress.

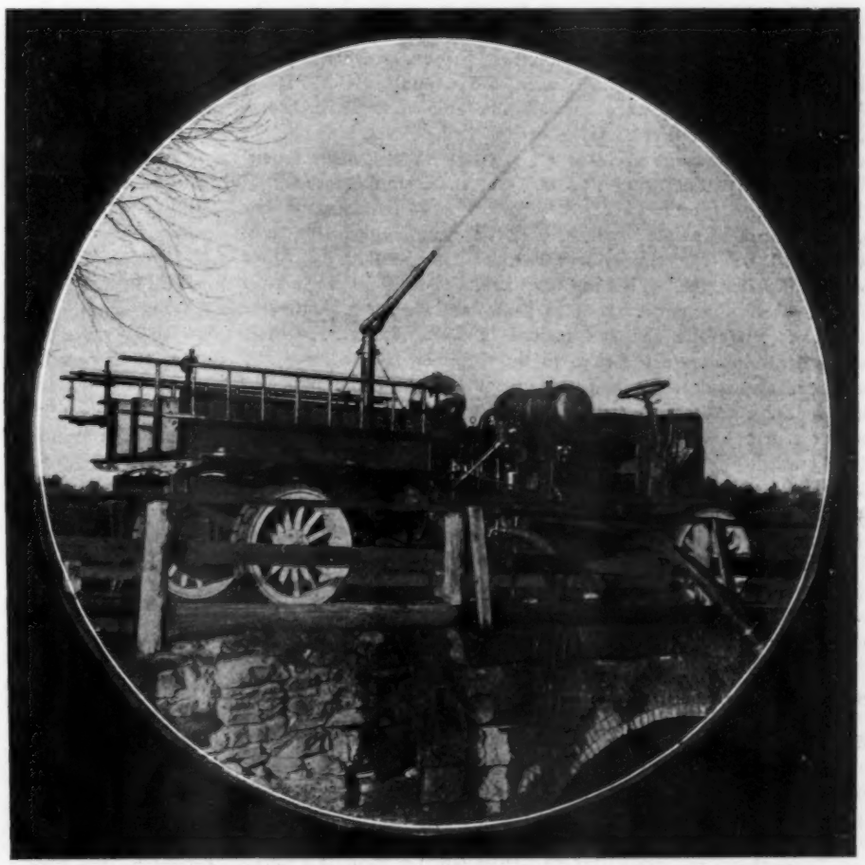


Fig. 8—Knox combination fire engine tried out at Springfield, April 24, in the presence of Fire Department officials

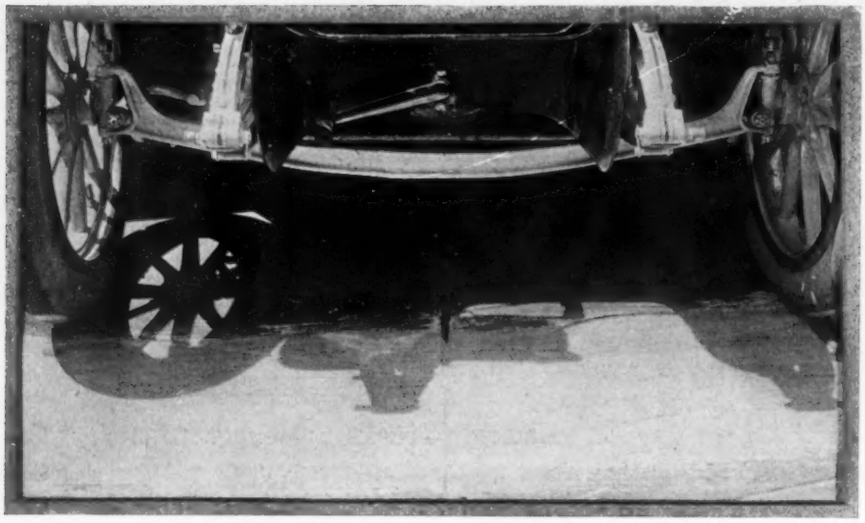


Fig. 1—Showing the car about to cross the whitewashed patch in order to test the inflation by imprint method.

Tire Testing by Imprints

IN a recent issue of THE AUTOMOBILE there appeared the results of some tests that were carried out to determine the amount of superficial area covered by a tire under varying pressure inflations. They were conclusive proof that underinflated tires offer a greater wearing surface to the roadbed than tires that are properly inflated. The method used for the purpose was to take a tube of Prussian blue and tone a small quantity down with turpentine. The mixture was painted on a section of the tire after the wheel had been jacked up and a piece of white paper placed on the floor of the garage, so that when the wheel was lowered the blued section of the tire imprinted on the paper the amount of its surface that would in the ordinary way contact with the ground. Other tests along the same lines were carried out, and in these instances the tire was blued first and the car pushed so that the contact width of the tire would leave an imprint on the paper. Another method of carrying this test out in a simple manner is shown in the illustrations. A strip of even surface of the garage floor is painted white with ordinary whitewash, and while still wet the car is driven over the patch. The first operation after the whitening has been effected is shown in Fig. 1, where the car is about to pass over the strip. The imprint left after the car had passed is seen in Fig. 2. It is not difficult to inflate the tires to their proper amount, run the car over the whitewash and measure the size of the imprint; and if the owner likes to go to the trouble of carrying the matter further he can make pressure tests for himself by letting out 10 pounds of air before each test. The maximum pressure test will suffice, however, as this is the size of imprint that the tire should give under ordinary circumstances. If the imprint that the tire leaves is larger than the initial test it is evident that the tires require inflation.

A certain amount of allowance must be made as the tire grows old, but the difference is not so great that the test will be upset by this calculation. To compensate for this a test should be made when one of the tires has run, say 1,000 and then again at 2,000 and 3,000 miles and the difference in tread width noted. By referring to Fig. 3 a difference will be noticed in the size of the imprints of the two front tires. The left tire (looking at the picture) was inflated to 60 pounds per square inch and the one at the right to slightly below 40 pounds. The difference in the size of the imprints was 5-8 inch.

There seems to be a prevailing idea among a certain class of chauffeurs that tires run better soft than when pumped up hard. Against this there is the opinion of the makers of tires and conclusive tests that have been carried out from time to time by competent judges. The owner should beware and choose for himself. Besides the fact that "the chauffeur says so" there comes the consideration that it is a lot of trouble to exert oneself to pump the tires. It must be clear to anyone that the less resistance the tire causes through increased tangential contact the greater efficiency can be obtained from a given horsepower. The more the width of contact area increases the greater will be the "pulling" on the walls.

Such a test as here illustrated gives a possibility for owners of a fleet of cars to supervise the inflation of their tires, and in the case where the tire does not come up to the standard the driver should be sent back to the garage and compelled to be more careful with the property left in his charge. The tests referred to in this article were made at the Independent Owners' Garage Company, 205-213 West End avenue, New York, and the car used for the purpose was lent by the White Company.

Disagrees With Duryea

HAVING read the communication of Charles E. Duryea in THE AUTOMOBILE of April 13 under the caption "From a Pioneer Builder," I take the liberty of generously disagreeing with him, more particularly on one or two of the counts. The gist of Mr. Duryea's communication is that it is satisfactory to add lubricating oil to the gasoline and feed the two elements to the motor through the carbureter, expecting that the gasoline will know enough to turn into fuel and the lubricating oil will have the good sense to go about its business of lubricating the bearings—excellent; overmuch to expect from distillates of "crude."

We learn from those who make it a point to know about such matters that an unbroken film is essential for good lubrication. I tried a little kerosene and lubricating oil on a surface for the purpose of noting the action and I soon found that an unbroken film is quite out of the question. The kerosene seemed to pierce the film of lubricating oil and instantly this is accomplished the excellent properties of the lubricant are destroyed.

From the purely lubricating point of view, having put some of the lubricating oil in the palm of my hand, and having then spilled a little kerosene oil into the

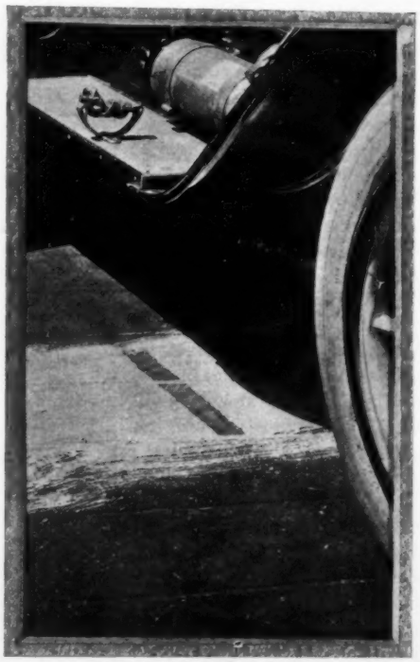


Fig. 2—The mark left by the tire after crossing patch

same, by rubbing them together it took but a moment to discover that the mixture fell far short in lubricating properties, as compared with the lubricating properties of the unadulterated lubricating oil.

In mingling lubricating oil with kerosene, while the two liquids seemed to mix and become one compound, the fact remains that as soon as the mixture was smeared over a surface the lubricating medium departed from its solvent, thus showing that the solvent properties of the kerosene are not all that Mr. Duryea would have us believe. Come to think of it, quite a measure of energy is expended in the distilling of the "crude," and if it takes considerable energy to separate the fractions, what I want to know is, how are they to be mingled to form a homogeneous mixture unless an equal amount of energy is expended in the process?

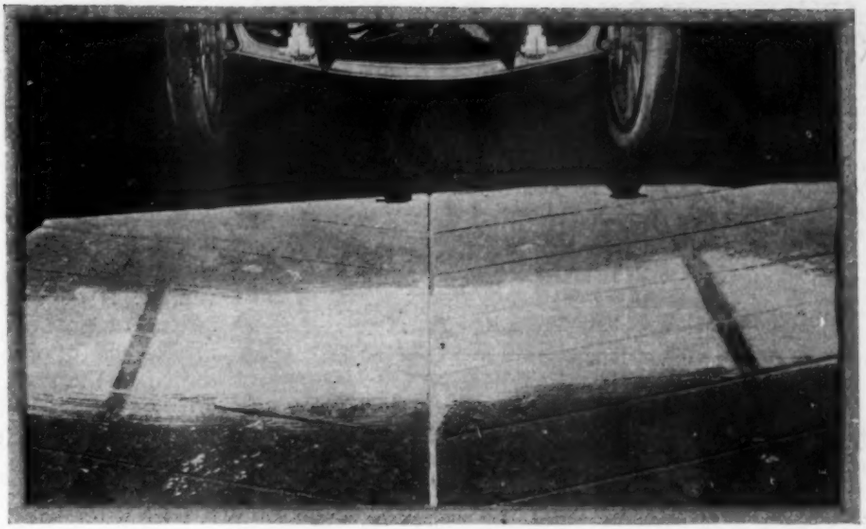
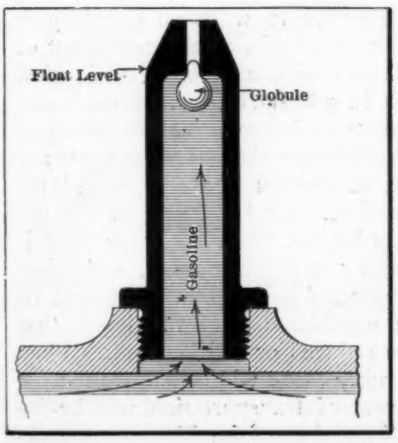


Fig. 3—Showing the difference in the sizes of imprints on white-washed surface made by tires with different pressures

In order to be able to see what would happen were lubricating oil dumped into the gasoline, I took a measure of the kerosene and to it having added a little lubricating oil, after mingling the two for a time and shaking the mixture vigorously to complete the formation, I then placed some of the liquid on a surface and watched its action. It took but a moment to observe that the "fat" was migrating in the direction of the surfaces; segregation was taking place. Instantly the "fat" collected with its kind, the group clung, after which the kerosene was drained off, leaving the "fat" in an isolated position, in undisputed possession of the field. This is not to say that the "fat" was in physical contact with the surface; on the contrary, the surface was wet with kerosene. The point here may best be illustrated. Take the nozzle as shown; if "fat" is mingled with gasoline in a system of a motor, what I contend is that the fat will segregate and when it floats up into the nozzle it will form a drop and plug up the small orifice of the nozzle in the manner as shown. This may not be enough to shut down the motor, but it will be sufficient in its influence to thwart the highest performance, making the torque of the motor more fluctuating than will be true were the motor fed with undiluted gasoline. As proof of the fact that kerosene in lubricating oil is not a good addition from the purely lubricating point of view, all that has to be done is to call attention to a well-established fact; if a multiple-disc clutch is working badly, what do we do? Place lubricating oil in it? No. We make a mixture of lubricating oil and kerosene and use it for clutch lubricating purposes. If the clutch slips this lubricant prevents the slipping. If a bearing runs hot, do we put kerosene in the lubricating oil to add to the lubricating properties of the same? No. The result would be disastrous.



Showing what happens if a globule of oil plugs up the carbureter jet

I contend that gasoline is best for fuel purposes when it is not littered up by lubricating oil or other foreign substances, and I conclude that lubricating oil will do its best work if it is not hampered by being thinned out, as it would be were it put into the gasoline, but I am sure that perfect mingling to form a homogeneous mixture is not possible under the circumstances that Mr. Duryea names. Were this so his argument would fall to the ground, for, as he says, but 2 per cent. of lubricating oil is placed in the gasoline—what would become of this small increment from the lubricating point of view if, as he states, it is dissolved in the gasoline?

Newark, N. J. AUTOMOBILIST.

Calendar of Coming Events

Catalogue of Future Happenings in the Automobile World That Will Help the Reader Keep His Dates Straight—Shows, Race Meets, Runs, Hill Climbs and Other Events.

SHOWS AND EXHIBITIONS.

April 26-29.....Utica, N. Y., Annual Show, State Armory.
May 1-6..... Burlington, Vt., First Annual Show.

RACE MEETS, RUNS, HILL-CLIMBS, ETC.

April 29.....Guttenberg, N. J., Track Races.
Date indefinite.....Oakland, Cal., Track Races, Oakland Motordrome.
Date indefinite.....Shreveport, La., Track Races.
April 29.....Philadelphia-Atlantic City Roadability Run. Quaker City Motor Club.
May .....Lancaster, Pa., Three-Day Endurance Run, Lancaster County Auto Trade Association.
May 5-8.....Los Angeles, Cal., Reliability Run, Los Angeles Times.
May 9-11.....Savannah, Ga., to Charlotte, N. C., Reliability Contest, Savannah Automobile Club.
May 13-14.....Latonia, Ky., Track Meet, Cincinnati Auto Dealers' Association.
May 15-18.....Washington, D. C., Four-Leaf Clover Endurance Run. Automobile Club of Washington.
May 25.....Chicago, Ill., Fuel Economy Test, Chicago Motor Club.
May 27-31.....Chicago, Ill., Five-Day Tour to Indianapolis, Chicago Automobile Club.
May 29-31.....Chicago, Ill., Tour to Indianapolis, Chicago Motor Club.
May 30.....Indianapolis, Ind., Five-Hundred-Mile International Sweepstakes Race, Motor Speedway.
June 15, 16, 17....Dayton, O., Midsummer Meeting Society of Automobile Engineers.
June 15-20.....Endurance Run, Cañon City, Col., to Hutchison, Kan.
June 19-25.....Glidden Tour, Washington, D. C., to Ottawa, Canada.
June 22.....Algonquin Hill Climb, Chicago Motor Club.
July .....Indianapolis, Indiana Four-State Tour, Indianapolis Auto Trade Association.
Aug. 25-26.....Elgin, Ill., National Stock Chassis Road Race, Chicago Motor Club.
Oct. 9-13.....Chicago, Ill., Thousand-Mile Reliability Run, Chicago Motor Club.

FOREIGN FIXTURES.

April 23-28.....Modena, Italy, Touring Car Contests.
May 1-15.....Turin, Italy, Automobile Salon.
May 7.....Sicily, Targa Florio Road Race.
May 14.....Barcelona, Spain, Catalona Cup Road Race.
May 21.....Ries, Austria, Hill-Climb.
May 25.....Meuse Hill-Climb, Belgium.
May 25.....Le Mans, France, Touring Car Kilometer Speed Trials.
May 28.....Le Mans, France, Hill-Climb for Touring Cars.
May 28.....Start of Touring Car Reliability Trials in Germany.
June 1.....Bucharest, Roumania, Speed Trials.

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AKRON, with an output of 100,000,000 pounds of pneumatic tires, as the estimated product for this year, which output is being exceeded at the present time, is an industrial center of the first magnitude, with a far-reaching influence, the estimate of which is yet to be made. It requires no great effort to generously disagree with the man who looks upon the automobile and its ramifications in the light of a luxury, unless to point out that this luxury is being shared by thousands of workmen in Akron who are given steady employment year after year in the plants where these tires are being made, and the thousands of other workmen who are employed in the driving of automobiles for which these tires are produced. While the leading story in THE AUTOMOBILE this week deals with the tire-making problem as it obtains in Akron, in reading this story it will be well to remember that the output of tires at this center does not exceed 55 per cent. of the total tire product of this country. In recounting the advantages that are derived from the making of tires, the direct labor item must be looked upon as only a part, it being the case that the cotton which is used in the fabric comes from mills where labor is employed, and the rubber that serves as the protecting medium demands its quota of labor, from the drawing of the latex through its many ramifications to the frictioning of the fabrics, by means of which rubber is coated onto the same to render it impervious to moisture.

SUPERFICIAL thought pricks the skin of yesterday in quest of a foundation upon which to rest the reasoning of the future, and abject failure is the result. There is no more sense in decrying the enormity of the tire industry than there is in depriving an infant of its modicum of milk. If the transportation equipment of to-day makes it necessary to supply tires as fast as they wear out, this is no license to forget that in the delivery of merchandise the work is done quicker, and the direct cost is lowered, remembering, too, that the indirect advantage is of considerable portent. In the meantime, instead of growing oats and other feed for horses, the tillable soil of our farms may either be rested up or turned to the good account which is represented in the growing of breadstuffs. In a broad sense, this latter consideration is of exceeding human advantage, and the most direct way to reduce the high price of living is to prune the cause.

* * *

TIRE maintenance is receiving its share of intelligent attention, and the results that are being reported are such as to indicate that heavy inroads are being made in the useless costs. When THE AUTOMOBILE announced in its columns that the pressure in tires was rarely ever up to the requirement, proof of which was clearly brought out by means of tire prints which appeared in the issue of November 10, it was then foreseen that this imprint process offered possibilities that would result in the saving of millions of dollars per year to the users of automobiles, and this point is being fittingly illustrated in the practical workings of one of the cab companies in New York City at the present time. The process that is being used is very simple. The sidewalk in front of the company's garage, over which the cabs must roll as they pass out, is given a fresh coat of whitewash at frequent intervals, and the width of the streak that is made by the contact of each tire as the cabs pass over the whitewashed strip is measured by an inspector whose instructions are to have the tires re-inflated if the width of the imprint as made by the contact of the tires exceeds a certain predetermined measure. There is no gainsaying the efficacy of this plan, and the method of its execution is available under all conditions of automobile service from the public garage down to the small establishment of the owner of a runabout.

* * *

SHOULD there be a desire to work an economy in conjunction with the automobile as an instrument of transportation it would be a simple thing to do in view of the careless manner in which streets and roads are maintained after the cost of improvement is incurred. As a broad proposition, tires are used because roads are bad, and in proportion as the roads are improved the draft on tires will decrease. Broken stone is cheaper than rubber, and it lasts longer. Moreover, the road is used in common between many automobiles, and when the time arrives for concerted action the whole cost of transportation will be considered, and the items that offend the most will be reduced or stricken out. When this time does arrive, broken stone will be substituted for rubber, and the total cost of transportation will be influenced by the alleviating effect of intelligent co-operation.

Savannah Club to Conduct Tour

Asks No Sanction for Big Interstate Road Run

The Savannah Automobile Club has issued entry blanks for a big reliability tour for next month and has asked no official sanction from the Contest Board. The club has framed its own rules, which are radically different from those of the Contest Board. Officials of that organization say that in case the tour is run as contemplated everybody connected with it will be subject to discipline, and the chances of the Vanderbilt Cup going to Savannah will be made very remote.

SAVANNAH, GA., April 26—The Savannah Automobile Club, one of the largest and most influential motoring organizations in the South and an applicant for sanction to hold this year's Vanderbilt Cup race, has announced a three-day reliability run from Savannah to Charlotte, N. C., for May 9-11.

Numerous entries have been secured and the event promises to be one of considerable importance in several ways. The club has not applied for sanction from the Contest Board and has framed its own rules.

Aside from the fact that the club did not ask for sanction, the rules provide for radically different classes that do not correspond with the regular rules, the entry blank reading: "Any car manufactured in America or abroad, with standard equipment, that will seat two or more will be admittable."

The club has named a Technical Committee which will be governed in part by the following regulation: "The Technical Committee and associates are empowered to make a ruling on any point which may arise and is not covered by these rules. The ruling in a measure will be governed by those issued by the Contest Board."

When information as to the status of the reliability run contemplated by the Savannah Automobile Club was asked of the Contest Board, it was said that no sanction had been granted to the club. The information was volunteered that if the club persisted in running its tour according to its own rules, everybody connected with the affair would fall under the official ban and that the chances for getting the Vanderbilt Cup this year would be remote.

"It's a misunderstanding—that's all," said the official in charge. "Mr. Granger, representative of the Contest Board, is a leading member of the club. We are taking up the matter with him today. A sanction for a tour only costs $25, but the money part of it is of no importance."

In reply to a wire inquiry by THE AUTOMOBILE, Arthur W. Soloman, secretary of the club, said:

"Savannah, April 25—Replying to your telegram to Mr. Granger, I wish to state that we have not pulled away from A. A. A. The tour will be run under the best supervision."

The difficulty that stands in the way of a sanctioned run is that stock car certificates have to be filed with the Contest Board thirty days before the cars described in them are eligible to compete. As the certificates of only a few cars had been filed up to April 9, the field in any stock car event must necessarily be extremely limited on May 9.

McAneny Hurls Bingham at Pavements

Following the airing of New York street conditions in THE AUTOMOBILE, whereby it was demonstrated that the disreputable pavements of the city cost the owners of automobiles alone at least $20,000,000 a year, the Bureau of Municipal Research has made a report confirming the basic facts as set forth in THE AUTOMOBILE and swift action has been taken by the authorities. The concrete evidence of this action is the appointment of General Theodore A. Bingham, formerly police commissioner, as chief engineer of the Bureau of Highways in Manhattan.

The original purpose of this bureau, in part at least, was to see that repairs to streets were properly made at the expense of the contractors who did the paving. Particularly in asphalt pavements an intolerable condition of unrepair has developed during the past six months, and under the contract for paving the contractors agreed to maintain the streets for certain periods. That small results have been accomplished by the bureau as at present constituted is too apparent to need any affirmation—one trip over the streets is enough along that line.

General Bingham, during his official life as an army officer, a member of the Presidential household and as an official of the city of New York, established a reputation for progressive and independent action, and his appointment to the post of chief engineer of the Bureau of Highways is a subject of wide felicitation.

Detroit Dealers Plan Tour

DETROIT, April 24—The Wolverine Automobile Club, which contains in its membership almost every member of the Detroit retail trade, as well as a large representation from the various factories, is shortly to make formal announcement of its first annual tour, which will cover an itinerary lasting a week. The route will be circular and will include the cities of Cleveland, Toledo, Buffalo, Toronto, Hamilton and London, the last three named being across the border in Canada.

Iowa Favors Convertible Bodies

DES MOINES, IOWA, April 24—Sixty-five Iowa Maxwell agents were in Des Moines this week at the headquarters of the United Motors Des Moines Company, the Iowa branch of the United States Motor Company. Horace DeLisser, vice-president of the United States Motor Company, addressed the agents, as did George Hathaway, Western supervisor. The consensus of opinion among the Maxwell dealers as expressed at the meeting was that the touring car, especially the car with a detachable tonneau, is in the most demand in Iowa.

Dr. Bosch Sails for Home

Dr. Robert Bosch was tendered a farewell banquet at Hotel Astor Wednesday evening, April 20, by the Bosch Magneto Company. At the table were Mr. Heins, president; G. Jahn, treasurer, and the various department heads. Dr. Bosch sailed for his home in Stuttgart, Germany, on Thursday morning.

Brown Heads Mais Truck Company

TOLEDO, O., April 24—Will H. Brown, vice-president and assistant general manager of the Willys-Overland Company, has resigned that position under date of April 20 and has accepted the presidency and general managership of the Mais Truck Company of Indianapolis.

Motor Trucks on Parade

AMID driving rain and aggravated by a chilling wind the annual commercial truck parade was held Saturday under the worst of weather conditions. It was a big success despite the drawbacks, as over 150 trucks and deliveries completed the route over the slippery asphalt and other sloppy pavements. Nearly 100 additional cars started from Seventy-third street and Broadway, but the tremendous demand for delivery wagons on Saturday afternoon led to their withdrawal en route.

The horse-equipped vans, trucks and delivery wagons were unable to hold up their end even for the few hours required for the parade, and numerous entrants in the affair sent hurry messages to their representatives to withdraw and come to the rescue of the horses.

A worse day for a spectacle and a better one for a test could not have been selected. The streets, already in a lamentable condition of senile decrepitude, were made almost menacing to horses by the rain.

The trucks, however, managed to negotiate the bad going with an ease and certainty that must have added to the prestige of the automobile. Unfortunately, the day was so bad that the enormous crowds of spectators that were expected all along the route of the parade stayed indoors.

Tht affair was handled by the Motor Truck Club, of which F. B. Porter is president. Mr. Porter acted as grand marshal, and was assisted by the following staff of aides: Henry S. Otto, A. N. Bingham, F. F. Alcoutt, William C. Wurster, J. H. Kinnard, W. A. Westlake, Emerson Brooks, G. R. Giroun and A. C. Dam. M. E. Lescaris, of the De Dion Bouton branch, had charge of the official cars, press, etc.

The route was from Seventy-third street and Broadway to Seventeenth street and out to 135th street. The finish was at the same point where the parade started.

The cars lined up in the cross streets east and west of Broadway, and at 1:30 o'clock the head of the line moved off on the disagreeable journey. There was a band in one of the Fifth avenue coaches, but on account of being closed in the efforts of the musicians added nothing to the impressiveness of the parade except in the line of humor.

The trucks made slow progress throughout the run because of traffic jams and slippery pavements, some of the delays being caused by the blocking of the streets by fallen horses who could not negotiate the going.

It was expected that at least 400 cars would take part, but fully 150 failed to put in an appearance at the starting line on account of the bad weather overhead. Fifty cars left the line at its south end to take up their regular work of delivery, and little groups of the paraders fell out all the way to the northern extremity of the route.

But at the finish there were almost 150 cars in line.

The following makes of commercial vehicles were represented: American, Anderson, Aries, Atterbury, Avery, Autocar, Alco, Bronx, Buessing, Commer, Chase, Buick, Ford, Franklin, Crown, Champion, Gibbs, Couple-Gear, Decatur, Detroit, Cadillac, Cartercar, De Dion, Grabowsky, General Vehicle, Gaggenau, Hewitt, Kelly, Garford, Knox, Lansden, Hudson, Mack, Mitchell, Locomobile, Lambert, Maxwell, Little Giant, Saurer, Packard, Oliver, Overland, Remington, Reo, Panhard, Martin, Maytag, Studebaker, Sampson, Schleicher, Schildwachter, U. S. Truck, White, Waverley, Ward, Walter, Victor and Veerac.

The Knox contingent wending its way along Fifth avenue

Q. C. M. C. to Open Season Saturday

PHILADELPHIA, April 24—Given fair weather on Saturday next the local automobile season will be officially inaugurated by the Quaker City Motor Club with its Fourth Annual Social Run to Atlantic City. With the approach of the day interest correspondingly increases, and there is every reason to believe that this year's event will be the enjoyable and eminently successful feature it has been since its inception by the Quaker City Motor Club in 1907. A final set of instructions clearly setting forth conditions of the run was adopted at a recent meeting.

Promptly at 12.30 noon Starter G. Hilton Gautert will send the first car away from the Hotel Walton, the headquarters of the club, the others to follow at half-minute intervals. Each driver will be handed a time card by Paul B. Huyette, chief timer, upon which the entrant will inscribe his time, which will be turned over to the time judge at the Hotel Strand, Atlantic City, at the finish. The official time will, of course, be sealed and not known to anyone until the completion of the run.

The huge Commer Truck attracted no little attention

Those who are not fortunate enough to capture the coveted trophies will not be compelled to come back empty-handed, for the club will give approximation prizes in the form of silver cups of special design to all participants.

Backwardness of the spring season has had a deterrent effect upon the number of entries so far received, 38, but there is no reason to believe that conditions will differ from those prevailing in preceding years, when entries came in with a rush the last week. The following entries have been received:

Entrant.	Car.	Driver.
Fred. C. Dunlap.	Buick.	Fred. C. Dunlap.
L. D. Berger.	Columbia.	Harry Walls.
A. T. James.	White (gas).	Ralph James.
Evans Church.	White (gas).	Evans Church.
Frank Hardart.	Winton Six.	Miss Emma Hardart.
Frank Hardart.	Elmore.	Miss May Hardart.
George E. Potts.	Winton.	George E. Potts.
P. D. Folwell.	Packard.	P. D. Folwell.
G. Hilton Gantert.	Stearns.	G. Hilton Gantert.
Charles J. Swain.	Winton.	Charles J. Swain.
J.C. Bartlett.	Woods Electric.	J. C. Bartlett.
J.C. Bartlett.	Woods Electric.	Mrs. J. C. Bartlett.
A. E. Adams.	Oldsmobile.	A. E. Adams.
E. B. Morgan.	Otto.	E. B. Morgan.
F. B. Hitchcock.	Stevens-Duryea.	F. B. Hitchcock.
Otto C. Feil.	Packard.	H. Van Fossen.
John L. Brock.	Winton.	John L. Brock.
M. S. Ogle.	Maxwell.	H. Ogle Krause.
E. Rush, Jr.	Oldsmobile.	E. Rush, Jr.
J. E. Mountain.	American Traveler.	J. E. Mountain.
Harry T. Rosenheim.	Cadillac.	Harry T. Rosenheim.
Joe Keir.	Mitchell.	Joe Keir.

Entrant.	Car.	Driver.
W. Moseley Swain.	Winton.	W. Moseley Swain.
Ralph Murray.	Chadwick.	Howard Murray.
Francis Worley.	Buick	Francis Worley.
John B. Mayer.	National.	Henry Schroeder.
Frank Shaw.	Locomobile.	Frank Shaw.
D. E. McAllister.	Reo.	D. E. McAllister.
United Motor Co.	Columbia.	C. Reeves.
J. Scanlon.	Packard.	J. Scanlon.
E. B. Stone	Haynes.	E. B. Stone.
Longstreth Motor Car Co.	Pullman.	W. C. Longstreth.
E. W. Taxis.	White.	E. W. Taxis.
Witman & Shutt.	Washington.	O. H. Witman.
J. Eagleson.	White.	A. Bigelow.
H. Y. Stevenson.	Kline Meteor.	F. Canfield.
F. Franco.	Chalmers-Detroit.	F. Franco.
J. Fred Betz, 3d.	Simplex.	J. Fred Betz, 3d.

Saurer Truck Nearing Its Goal

CAMP TROUBLE, WHITE MOUNTAINS, Arizona, April 12—Through storms of rain and hail, and over trails that possessed

Studebaker division lining up for the parade

every disadvantage from the viewpoint of truck operation, the transcontinental Saurer truck has forced its way across the Continental Divide, and is now descending the long trail to the Pacific.

The unusually stormy conditions that have been encountered have resulted in small progress for several days.

The following tabulation shows in detail the trials that the truck has undergone:

Date.	From	To	Miles.	Hours.	Temp.	Weather and Roads.
March 25	Albuquerque	Camp Adobe	24.2	8:50	46°	Clear, sandy.
" 26	Camp Adobe	Camp Rincon	31.8	9:25	52°	Clear, sandy and rutty through Abo Pass.
" 27	Remained in camp to take up connecting rod bearings.					
" 28	Camp Rincon	Camp Ojo la Llana	28.1	10:30	66°	Clear, sandy.
" 29	Camp Ojo la Llana.	San Antonio	22.6	9:15	68°	Clear, sandy and rough via Carthage Coalmines.
" 30	San Antonio	Socorro	11.2	2:00	68°	Clear, good.
" 31	Socorro	Magdalena	29.1	8:35	64°	Clear, steep and narrow through Lemitar Canyon.
April 1	Remain at Magdalena to provision.					
" 2	Magdalena	Camp Golden Sunset	21.7	10:00	36°	Snowstorm, sandy
" 3	Camp Golden Sunset	Pine Camp	19.2	9:30	42°	Rainstorm, muddy.
" 4	Remained in camp (in Datil Forest Reserve) to wait for road to dry.					
" 5	Pine Camp	Camp Delmonico	9.6	7:20	54°	Cloudy, muddy and steep over summit of Datil Mts.
" 6	Camp Delmonico	Saladito	12.1	5:55	46°	Hailstorm, rough road across Continental Divide.
" 7	Saladito	Quemado	17.	8:40	52°	Rainstorm, wet adobe.
" 8	Quemado	Remain on account of rain all day				
" 9	Quemado	Camp Rector	11.7	6:00	58°	Cloudy, soft.
" 10	Camp Rector	Camp Mormon	24.1	10:15	54°	Clear, windy rough.
" 11	Camp Mormon	Camp Fisher Creek	28.2	10:25	56°	Clear, rough through Springerville.
" 12	Camp Fisher Creek	Camp Trouble	2.5	8:30	48°	Clear, bottomless mud up the steep sides of White Mts.

THE AUTOMOBILE is under obligations to A. L. Westgard for the above information.

A bunch of the participants led by the Sampson delivery

Cayuga Ferry to Open Soon

Syracuse, N. Y., April 24—The Automobile Club of Syracuse is now sending out notices to the various garages in this city and surrounding communities that the Cayuga ferry is scheduled to be resumed next week. Two boats instead of one are promised for this year, a matter of interest to all tourists between Syracuse and Rochester. Meanwhile, till the ferry starts, tourists are going to the village of Cayuga and taking the towpath to Seneca Falls. From Syracuse to Auburn and from Geneva to Buffalo there are now continuous stretches of State road.

Glidden Pathfinder Starts

Carrying S. M. Butler, Howard Longstreth, E. L. Ferguson and Nathan Lazarnick, the pathfinding car for the Glidden tour, a Stevens-Duryea six-cylinder, 43-horsepower automobile, left Washington on Monday. The first day was spent in selecting a route from the capital to Philadelphia and the second carried the party to New York, via Lakewood, N. J.

Save for a few unimportant details, the route of the first day may be found on pages 634 and 635 and 613 to 617 of Volume 3 of the Automobile Blue Book for 1911. This route is over the best available trunk road between Washington and Baltimore and includes 33 miles of excellent macadam pike. From Baltimore the road follows the main traveled highway through Wilmington, via Havre de Grace, crossing the Susquehanna over the new iron bridge.

The route for the second day may be found generally in the same volume of the Blue Book on pages 321 and 259-261.

In order to make the required distance for each day it may be necessary to deviate from the good roads and direct routes of the Blue Book in spots, but as a general thing the touring information is fully carried in the volume.

Glidden Pathfinder and party at the start of the route-making trip in Washington

Motor Plow for Small Farms

Syracuse, N. Y., April 24—A motor plow which it is claimed is destined to have a considerable effect on farm work has been invented by Alexander T. Brown, Syracuse capitalist and inventor. The initial trials were held last week at the Harrison farm, Cortland. One trip of the motor plow the length of the field and back demonstrated its ability to plow nine-tenths of an acre of ground in one hour, and it is claimed this efficiency will be increased before the machines are placed upon the market.

Mr. Brown and C. C. Greenfield have been working on the machine for a year, and the latter superintended its construction. E. E. Harrison, an expert machinist, also assisted and with Mr. Greenfield operated the plow this week.

This motor plow is the only one of its kind in existence. It is 15 feet in length, weighs between 6000 and 6500 pounds, carries a 20-horsepower, four-cycle, two-cylinder opposed motor and cuts two 14-inch furrows.

Among the ingenious features of the machine is a device which eliminates the necessity of steering it while in operation, or of making any turns in the plowing of a field. It is equipped with four plow bottoms, two at each end, and in operating works backward and forward across the field shuttle-wire, in this manner:

The motor plow is run the length of the field with the two blades at the right of the operator cutting two furrows. Then the engine is reversed and the bottoms at the right are lifted while those at the left hand are lowered. The large wheel, which

Motor plow invented by Alexander T. Brown, of Syracuse, N. Y., which can turn up nine-tenths of an acre of ground in an hour

has been rolling in advance, swings across the end and sets the machine over the distance necessary for the next two furrows, and then back to its original position.

The clutch is thrown in, and going back the wheel, which was in the rear of the working bottoms while operating in the opposite direction, is now in advance and follows the furrow which has been already cut.

It is stated that this plow will be marketed at a price which will not be beyond the means of the average farmer, while in localities where the farm land is held in sections of small acreage it is probable that one man in the district owning one of the plows will do the work of all, charging by the acre.

When the machine is fully equipped it will have a canopy, allowing it to be operated in wet weather, and lights, so that it may be run nights if necessary. It is considered hereabout that the motor plow is the last word in farm machinery. Great interest has been aroused among the farmers.

Framing Truck Contest Rules

Rules for the government of motor truck contests are being completed by the rules committee of the Manufacturers' Contest Association and will be announced in about a week. The committee which has this work in hand is composed of the following: Howard Marmon, chairman; C. P. Coleman, Saurer; A. W. Markham, Mais; Walter C. White, White; James M. Carples, Daimler Import Co.; Max Grabowsky, Grabowsky.

The following new members of the association have been elected: Federal Motor Truck Company, Rapid Motor Vehicle Company and the General Vehicle Company.

Model H Reo light delivery wagon used by the Cox Bottling Company, of Wichita, Kansas

Richmond to Have Kline Factory

Richmond, Va., April 24—Application has been made to the State Corporation Commission of Virginia for a charter for the Kline Motor Car Corporation, with a capital of $500,000, which will manufacture in this city the "Kline Kar." The application was made by Attorney Emmett Seaton and the charter was granted Friday, April 21.

The officers of the company are as follows: President, S. E. Bailey, of Philadelphia; vice-president and treasurer, Samuel W. Meek, of Richmond; secretary, D. R. Midyette, of Richmond. The board of directors are S. E. Bailey, Philadelphia; James A. Kline, York, Pa.; Warner Moore, T. S. Winston, H. D. Eichelberger, D. R. Midyette, S. W. Meeks, W. B. West, William H. Swartschild, Emmett Seaton, W. H. Warren and W. F. Gordon, of Richmond.

The plant will be in readiness for operation by September 1 of this year. It is estimated that the plant will cost about $150,000, and will employ from 500 to 1000 skilled mechanics. Final arrangements for the location will not be made until the officers are satisfied that they have the best location for trackage and street car facilities for their employees.

The manufacturing building will be rectangular—400 by 60 feet—and will be two stories high. There will also be an administration building on the grounds, which will contain the offices and draughting rooms and an observatory on the third floor, from which movements of demonstrators may be watched by the experts. Surrounding the plant will be a half-mile track, which will be used for testing and demonstration of the cars.

The plant will be equipped with the latest improved machinery for the manufacture of all parts of the machines, so that the machines will be made here throughout and not assembled.

As under the present management of the York, Pa., concern, the cars turned out here will range from a four-cylinder, thirty-horsepower roadster to a six-cylinder, sixty-horsepower car, including also a heavy truck. The capacity of the local establishment, it is estimated, will be annually 2500 cars of the various types.

Sampson truck delivering a four-ton load of machinery in Lee, Mass., after a haul from Pittsfield

Mr. Kline will be the engineer and general manager here, and S. W. Meeks will for the most part have charge of its business affairs.

President Bailey is the principal factor in the S. E. Bailey & Company, of Lancaster, Pa., and the York Carriage Company, York, Pa.

Mr. Bailey says that he came to Richmond upon the invitation of S. W. Meek and O. J. Sands, of Richmond, and that after an examination of the labor conditions, freight rates and general trade advantages became convinced that there is no place better fitted for manufacturing than Richmond.

Mr. Bailey says further that the establishment of the enlarged plant in Richmond will in no way affect the continuance of the operation of the plant at York, Pa., now owned by the Kline Motor Car Corporation, but that the York plant will be continued.

World's Marks Lowered on Beach

Daytona, Fla., April 24—Three world's records were made on the beach here yesterday by a special Benz car driven by Burman. The new marks were those for the flying mile, kilometer and two miles, all of which had been held for over a year by the same Benz car driven by an operator who is now under official ban. The time made in the mile trial was 25.40 seconds; in the kilometer, 15.88 seconds, and the two miles in 51.88 seconds. The mile was made at the rate of over 141 miles an hour.

To Standardize Automobile Words

To revise and standardize the nomenclature of technical motordom the Nomenclature Division of the Standards Committee of the S. A. E. will meet to-morrow afternoon at 1:30 o'clock at the Automobile Club of America. Some important work along this line will be taken up.

Faigley Joins Gibney Sales Force

Philadelphia, April 24—S. H. Faigley, formerly sales manager of the Pitner Pump Company, has joined the sales force of **James L. Gibney and Brother**, of this city, and will travel throughout the country for that firm.

Havers Six to Sell at $1,500

Quite remarkable is the list price fixed for the sale of the new Havers six-cylinder car which has been announced by the Havers Motor Car Company of Port Huron, Mich. Equipped with roadster body, this car will be marketed at $1,500, and with a full-sized touring body, the price will be $1,650.

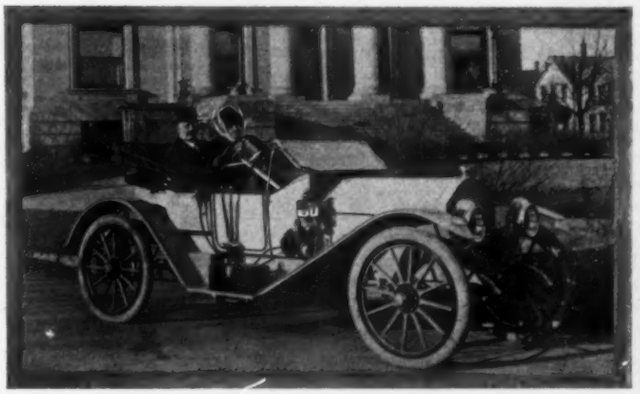
The same chassis is used for both types, the wheel-base being 115 inches. The wheels are 36 inches in diameter and will take 3 1-2-inch tires. The motor is watercooled and the cylinders, which are 3 3-8 by 3 3-4 inches, are cast in pairs. Schebler carbureter, Bosch dual high-tension ignition, cone clutch, selective sliding gear transmission, giving three forward speeds and reverse, Mercedes type radiator and two complete sets of internal expanding and external contracting brakes operated on steel drums, 12 inches in diameter, are some of the operative and structural features claimed for the car.

Strict Automobile Law in Nebraska

Lincoln, Neb., April 24—The Nebraska Legislature passed a new automobile law at the session just closed, which provides still more strict regulations for automobiles, with the idea of lessening the number of accidents.

Probably the strictest feature is the one relating to the passing of a car by an automobile. This law provides that where street cars are operated, automobiles must be stopped at crossings where passengers are getting on or off the car.

The driver of an automobile is required to bring it to a full stop on signal from the driver of a horse showing signs of fright. The penalty for violation is a maximum fine of $50 for the first offense. From $50 to $100 or sixty days in jail for each subsequent offense.



Showing the new Havers "Six," listed at $1,500

The registration for automobiles is raised from $1 a year to $2, motorcycles remaining $1. But the new law provides that instead of this money going into the State treasury it is turned back to the county in which the owner lives. There it is to go into the good roads fund. This will mean an extra $35,000 at least for good roads annually in Nebraska.

Manufacturers and dealers may take out a single license for all cars of one type in their possession, the different types being classed as gasoline, steam and electric.

The act prohibits any person under sixteen years of age from driving an automobile.

Good Roads Activity Strikes Illnois

Chicago, April 22—Apparently Illinois has just awakened to the need of good roads, and at the present time movements have been started to lay out two trunk lines across the State—one from Chicago to Moline via Elgin, and the other from Chicago to St. Louis via Joliet and Springfield.

New Things Among the Accessories

Brunswick Recoil Checks

HOWEVER supple and easy riding the spring of an automobile may be, the autoist feels more secure if the car is fitted with shock absorbers. The duty of a shock

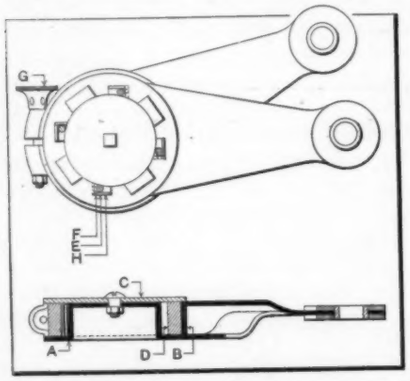


Fig. 1—Cross-sectional view of the Brunswick Shock Absorber

absorber is to dampen the shocks inflicted on the springs primarily, and in a measure on the whole car, thereby relieving them of the rough riding effects that bad roads bring with them. The Brunswick shock absorber, built under the Kelcey patents, is designed to check the recoil of the springs, and thus prevent their breakage and relieve the steering of the jolts due to road inequalities. A cross-section of the device will be seen by referring to Fig. 1. The arm connecting the part A is bolted to the axle and the part B to the chassis frame. When the car receives a jolt the two fulcrum arms move toward each other and on the recoil move in the opposite direction. With the first motion the cast iron ring D and the steel friction band B, owing to friction move as one piece and turn freely as one piece on the hub A. On the recoil the hardened pin E is wedged between the part A and the steel shoe H which locks A and D fast, and the recoil is taken up by the friction band D. This friction is under the control of the driver and can be regulated to any desired degree by the graduated screw G. The mechanism is self-lubricating, and the whole is enclosed in a dust-proof case. The fitting is manufactured by the Brunswick Machine Company, New Brunswick, N. J., and the distributing agents are the Livingstone Radiator & Manufacturing Company, 136 West Fifty-second street, New York City.

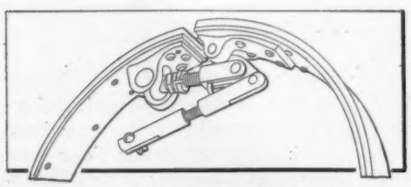


Fig. 2—View of the Duplex internal expansion brake, showing the method of operation

Duplex Internal and External Brakes

PRESUMING that a car is made to run well, there is one part that should never be overlooked in the designing or maintenance, and that is the brakes. It is one thing to make the car go fast and it is another to stop it, and of the two perhaps the latter is the more important factor. The Duplex brakes shown in Figs. 2 and 5 are of the internal expansion and external contacting type respectively. As will be seen in Fig. 2, the internal type has two points of adjustment, and the tightening of the rod acts upon each half of the shoe equally. The external contacting type, as seen in Fig. 5, utilizes the wrapping or winding effect of a flexible band, encircling and in contact with a rotating drum. One end of the flexible band is fixed, while the operating force is applied to the other end in the direction of the rotation of the drum. In order to obtain this effect in both directions of rotation means are provided by

Fig. 3—Sectional view of the Allen tyrometer pressure gauge

which either end of the band automatically becomes the fixed end. This device is manufactured by the Royal Equipment Company, Bridgeport, Conn.

Handy Tire Pressure Tester

MEASURING 4 1-2 inches by 1-2 inch, the Alban Tyrometer consists of a drawn brass tube, as shown in Fig. 3. When the gauge is pressed on the valve the rubber washer in the end of the tire valve makes an air-tight joint with the tyrometer, and the valve plunger is at the same time opened. The air pressure acts upon a spring tension attached to a plunger in the gauge, which is forced to a point equal to the amount of pressure in the tire. This plunger raises the sliding band indicator, which through a slight friction remains in position, thus retaining the indication after the gauge has been removed from the valve. This gauge is manufactured by the Allen Auto Specialty Company, 1926 Broadway, New York.

Saves Tire Depreciation

A PORTABLE vulcanizer should find a place in the autoist's kit. The Pittsburg Steam Vulcanizer consists of a hollow shell in which a small amount of

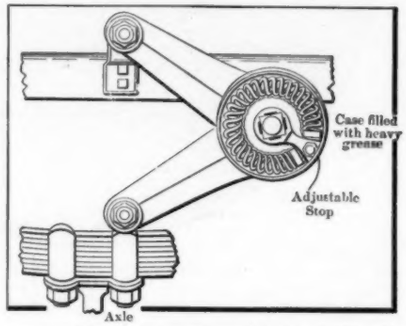


Fig. 4—View of the Brunswick Shock Absorber with dust cap removed

water is used to generate steam. The steam pressure can be read on a gauge supplied with the outfit, which includes a concave plate for clamping on the shoe and a flat table with collapsible feet for tubes. All necessary tools for carrying out the work form part of the outfit. It is made by the Motor Tire Repair & Supply Co., Baum street, Pittsburg, Pa.

Shock Absorber on Coiled Spring Principle

CONSISTING of a triple coil compensating spring enclosed in a dust-proof casing, the Penfield shock absorber has recently been placed on the market. The method of operation is seen by referring to Fig. 4. The two fulcrum arms are attached to the frame and axle respectively, and when the compression of the spring takes place, the coil spring is tightened, thereby placing a resistance against the car springs. An adjustable stop is fitted, whereby the tension of the spring may be altered to suit the particular requirements of any make of car. It is manufactured by the Penfield Shock Absorber Company, 49 Randolph avenue, Meriden, Conn.

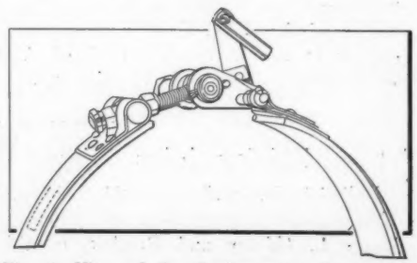


Fig. 5—View of the Duplex external expansion brake, which is made to operate in both directions